BRITISH JOURNAL
OF
OPHTHALMOLOGY

INCORPORATING
THE ROYAL LONDON OPHTHALMIC HOSPITAL REPORTS
THE OPHTHALMIC REVIEW AND THE OPHTHALMOSCOPE

VOL. 37 *DECEMBER 1953* NO. 12

EDITORIAL COMMITTEE

Chairman:
SIR STEWART DUKE-ELDER, K.C.V.O.

J. H. DOGGART (*Secretary*)

J. D. MAGOR CARDELL
A. J. B. GOLDSMITH
J. R. HUDSON
S. J. H. MILLER
F. A. WILLIAMSON-NOBLE
EUGENE WOLFF
and the EDITOR of the *British Medical Journal*

LONDON
INSTITUTE OF OPHTHALMOLOGY
JUDD STREET, W.C.1.

Publishing Office
BRITISH MEDICAL ASSOCIATION
TAVISTOCK SQUARE, W.C.1.

THE LISTER-MORTON OPHTHALMOSCOPE

WITH BATTERY IN HANDLE AND WITH ALTERNATIVE HANDLE FOR USE WITH MAINS

No. 495
with battery
in handle.

No. 0495/9
with handle for
use on mains with
transformer or
resistance.

Introduced in 1928 Hamblin's Lister-Morton Ophthalmoscope remains the Standard amongst electric ophthalmoscopes with a performance that has yet to be surpassed. The lighting system has been designed to cut down corneal reflex to a minimum and to eliminate reflections, thus making it possible to carry out a direct examination of the macular region in a fully lighted room without using mydriatics

The battery model being self-contained is ideal for bedside examination, but operation from the mains is usually preferred in the consulting room.

A good arrangement for a busy Surgeon is to use the battery model for visiting purposes and to have an interchangeable mains handle complete with lamp and condensing system for consulting room purposes.

THEODORE HAMBLIN LTD
DISPENSING OPTICIANS
15 WIGMORE STREET
LONDON W.1.

Brit. J. Ophthal. (1953) 37, 705.

COMMUNICATIONS

OCULAR COMPLICATIONS OF DIABETES MELLITUS*†

BY

G. I. SCOTT

Edinburgh

THERE is no doubt that the retinal changes which may occur in diabetic patients are by far the most important ocular complication of the disease.

It is now generally recognized that there is a type of retinopathy peculiar to diabetics, which is quite distinct from that occurring as a result of hypertension or arteriosclerosis.

Ballantyne and Loewenstein (1943), reviewing a large series of diabetic patients, found that 50 per cent. of those with retinal changes had normal blood pressure and that many showed no arteriosclerotic changes in the retinal vessels.

Wagener (1945), who at one time (Wagener and Wilde, 1921) had expressed the view that the retinopathy of diabetes was essentially that of arteriosclerosis, stated that, as a result of 25 years' further clinical experience, he was quite definitely of the opinion that neither arteriosclerosis nor hypertension produced retinopathy of the type characteristic of diabetes.

Material of the Present Report

Some years ago, in conjunction with Dr. Halliday Croom, I examined 124 diabetic patients, all of whom had had diabetes for periods varying from 15 to 26 years, and the findings in this group were recorded by one of us (Croom, 1950) in a consideration of the prognosis for the diabetic patient.

Since that time this group of patients under our observation has increased to 150. In our study, the blood pressure was regarded as normal if the systolic pressure was below 140 and the diastolic below 90. Patients were regarded as definitely hypertensive if the systolic pressure was 160 or more, or if the diastolic was 100 or more, and as doubtfully hypertensive if they exhibited blood pressures between these two levels.

*Received for publication August 26, 1953.

† Opening paper read at the Annual Congress of the B.M.A., at Cardiff, in July, 1953 (Section of Ophthalmology).

The distribution of the hypertensive cases is shown in Fig. 1; it will be noted that 35 of the 62 cases with retinopathy showed no evidence of hypertension.

In our first review of sixty of these patients (Croom and Scott, 1949), only two showed albuminuria and oedema, which led us to the conclusion that the nephrotic syndrome associated with diabetes, while a pathological entity, was a relative clinical rarity, as had, in fact, been suggested by Kimmelstiel and Wilson (1936) in their original description of the condition.

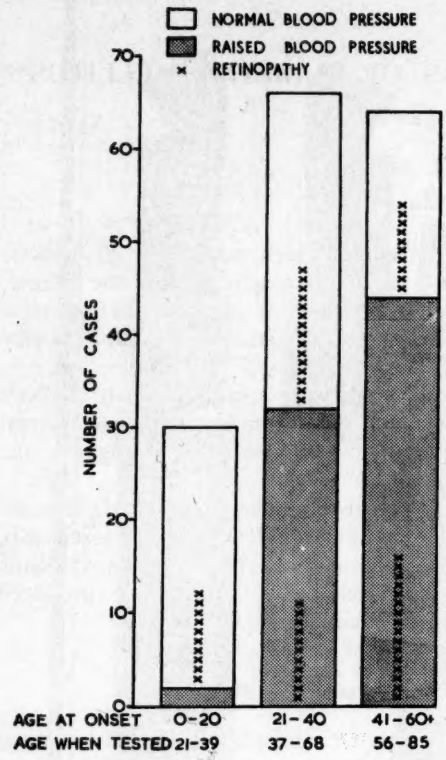

FIG. 1.—Distribution of cases with retinopathy, to illustrate that hypertension is not a necessary factor in the production of diabetic retinopathy.

During the past few years, however, a few more of our patients have developed this complication. It would appear, therefore, that the incidence of this syndrome is increasing, as, in fact, one would expect in view of the increased duration of life of the diabetic patient.

We assessed the severity of the diabetes by the dosage of insulin required, and the control of the condition by the general well-being of the patient, the degree of glycosuria, and the frequency of reactions.

Ocular Pathology

In this series of 150 patients, as in our previous reviews, there was no significant correlation between the severity of the disease and the development of cardiovascular or retinal complications. In so far as retinopathy is concerned, I am sure that it occurs quite as frequently, if not more commonly, in patients with a mild degree of diabetes.

Wagener (1945) reviewed the ophthalmic findings in 1,021 diabetics examined at the Mayo Clinic during the year 1944. When the incidence of retinopathy was correlated with the duration of the diabetes, it was found to be 10.7 per cent. in those who had had diabetes for less than one year, 22.0 per cent. in those who had had the disease for 1 to 10 years, and 73 per cent. in those who had been diabetics for more than 20 years.

There thus seems to be no doubt that the incidence of retinopathy increases with the duration of the disease.

Within the space of two years (1943–1945), therefore, two factors were established: first, that a characteristic form of retinopathy can occur in diabetics which is independent of hypertension and unaccompanied by arteriosclerotic changes in the retinal vessels; secondly, that the incidence of this retinopathy varies with the duration of the disease.

We also know that the incidence of retinopathy is in no way related to the severity of the diabetes.

Joslin and others (1946) drew attention to the diabetic's increased expectation of life. In a review of 28,000 diabetics treated at Boston since 1898, it was shown that immediately before the introduction of insulin in 1922, a child who developed diabetes at the age of 10 years had an expectation of life of only 2·6 years, whereas by 1938 the expectation of life had increased to 39·8 years.

If one now considers these two factors, the increased expectation of life and the fact that the incidence of retinopathy increases with the duration of the disease, it is apparent why earlier observers maintained that retinopathy practically never occurred in young diabetics. The answer is simply that, before the introduction of insulin, the young diabetic rarely lived long enough to develop it.

Mackenzie (1877), in recording the clinical and histological findings in a patient who had died of diabetes mellitus, drew particular attention to the distension of the retinal veins and the presence of minute aneurysms on the capillaries. Nettleship (1877) suggested that these aneurysms might explain the occurrence of haemorrhages into the vitreous.

Mylius (1937) suggested that stasis in the veins was the essential factor in the causation of retinopathy in diabetes, but the significance of the venous changes was not truly appreciated until our thoughts were directed away from such factors as hypertension and retinal arteriosclerosis.

Ballantyne and Loewenstein (1943), recognizing that diabetic retinopathy and hypertensive retinopathy were two separate entities, rediscovered the capillary dilatations and demonstrated localized fatty degeneration in the walls of the small venules.

The more recent work of Ashton (1949) has confirmed that these lesions are in fact true micro-aneurysms and not merely capillary dilatations, and Ashton (1951) has shown that, while some of these lesions may commence as minute diverticulae arising on one side of the vessel wall, they arise more frequently from loops in the vessels which become varicose. Exudate then oozes through the vessel walls and the two loops become adherent, explaining how a large aneurysm may appear on an otherwise normal-looking capillary.

Stages of Diabetic Retinopathy

From the clinical point of view, I have already suggested (Scott, 1951) that

we should adopt a classification (Fig. 2) slightly different from that used by the pathologist, to illustrate the various stages in the clinical course of this important complication of diabetes.

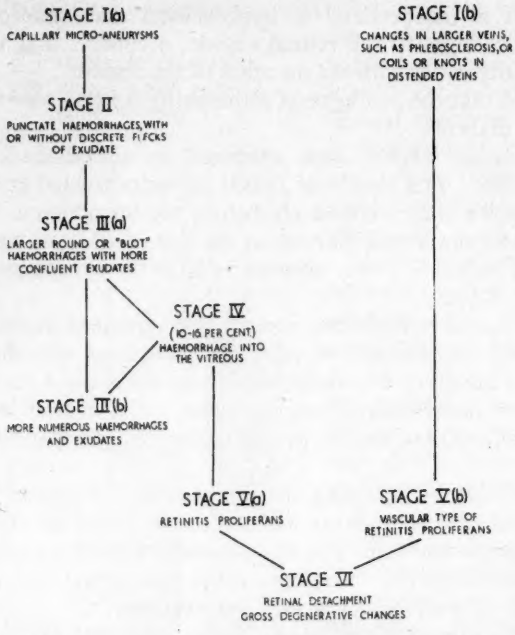

FIG. 2.—Clinical classification of the various stages of diabetic retinopathy.

At the commencement, the process is largely confined within the walls of the veins with the production of multiple micro-aneurysms, and perhaps a few haemorrhages (Stage I (*a*), see Fig. 3). In a smaller group of cases there may be characteristic, but not specific, changes in the larger veins, which may be distended and show loops or coils (Stage I (*b*)), as described by Ballantyne and Loewenstein (1943).

The next stage is the further escape of blood into the deeper layers of the retina, with or without the formation of exudates, the earliest stage consisting of punctate haemorrhages with perhaps a few flecks of exudate. (Stage II).

As this process progresses, the condition gradually changes to dot and blot haemorrhages, with more confluent exudates (Stage III (*a*), see Fig. 4).

In the minority, in which further deterioration occurs, the progress of the disease follows one of two very different courses. A certain number of cases show an exacerbation of the changes seen in Stage III (*a*), the haemorrhages becoming more numerous and the exudates more confluent and more waxy in appearance, producing the text-book picture of the fundus appearances (Stage III (*b*)).

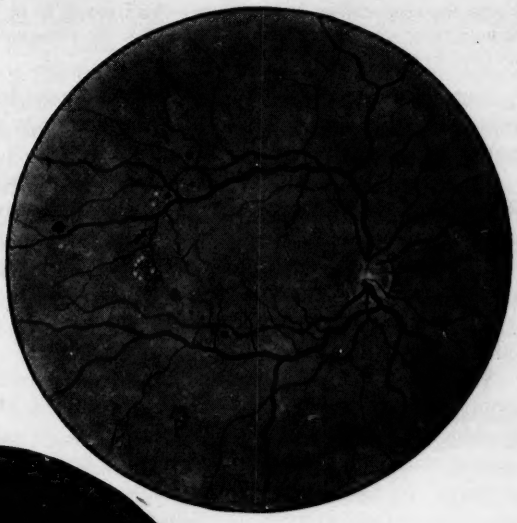

FIG. 3.—Diabetic retinopathy—Stage I (*a*).

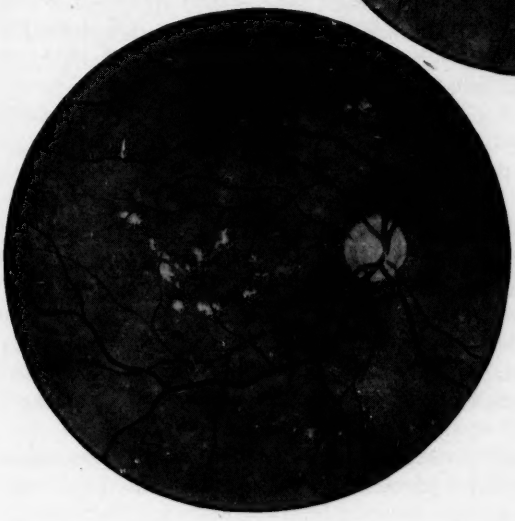

FIG. 4.—Diabetic retinopathy—Stage III (*a*).

In other cases, however, a sudden haemorrhage into the vitreous may occur, which will inevitably be followed by the development of proliferative changes, resulting in that not so rare disaster, retinitis proliferans.

Retinitis Proliferans

It is, I think, important to recognize that bleeding into the vitreous may occur in the presence of relatively slight retinal changes such as I have described as occurring in Stage III (*a*), where the haemorrhages may be few in number. The only feature suggestive of possible disaster may be the fact that one or two of the haemorrhages are superficial and almost pre-retinal in position. As Hanum (1938) has expressed it:

From these pre-retinal haemorrhages there seems to be but a floating transition to the apoplectiform haemorrhages which involve the vitreous and, probably always, give rise to proliferative changes.

Since the occurrence of this condition is dependent upon pre-existing retinal changes, its incidence primarily depends as in the case of the retinopathy, upon the duration of the diabetes.

Joslin and others (1952) review 326 cases of retinitis proliferans. In nearly 90 per cent. the patients had had diabetes for more than 5 years, and in 51 per cent. the duration of the diabetes exceeded 15 years. In nearly 40 per cent. this complication occurred before the 40th year, but in 71 cases (22 per cent.) it occurred after the age of 60.

In our series, the ages of our six patients with retinitis proliferans were 27, 33, 42, 46, 57, and 62.

With regard to the likelihood of a diabetic patient with retinopathy developing retinitis proliferans, Wilson, Root, and Marble (1951) have reviewed a series of 247 patients with diabetes of 10–34 years' duration, among whom they found 158 (63·9 per cent.) with diabetic retinopathy. Of these 158 patients, 26 had developed retinitis proliferans, an incidence of 16·4 per cent. of the total number of cases with retinal changes.

In our Edinburgh series of 150 patients with long-standing diabetes, there were, as I have said, 62 cases (41·3 per cent.) with retinopathy, and six of these (9·7 per cent.) developed retinitis proliferans.

Prognosis as regards Vision

It is important to remember, as Lawrence (1951) has emphasized, that the appearance of a few micro-aneurysms or haemorrhages in the fundi of a diabetic does not necessarily mean that he will suffer early impairment of vision, since serious macular involvement may not occur for many years.

Marked congestion of the veins and the occurrence of superficial blots of haemorrhage offer a much worse prognosis than scattered deep haemorrhages and exudates.

Even in the case of retinitis proliferans, useful vision may, in some cases, be preserved for as long as 5 or 6 years.

Prevention and Treatment of Retinal Changes

An increasingly high proportion of diabetics are showing such changes and, in the absence of adequate preventative measures or treatment, the number will undoubtedly increase.

In an analysis (Croom and Scott, 1949) of our first sixty cases of patients with long-standing diabetes, we found no correlation between the occurrence of vascular or retinal changes and the control of the diabetic state.

In our more recent review of 150 patients, we also found no significant difference in regard to " control ", in that, of the 62 cases with retinopathy, thirty were uncontrolled and 32 apparently well-controlled.

We had, however, a considerable number of patients whom we had labelled " defaulters ". While we knew that these patients were " well-controlled " or " not controlled " upon the occasions when they reported for review, they were irregular in their attendances for follow-up examination. We felt, therefore, that there was certainly a possibility that apparently " well-controlled " diabetics might not, in fact, be fully controlled during such periods of default. In fact, 51 per cent. of our patients had been "defaulters".

These patients were, as it happened, almost equally divided between our uncontrolled patients and those apparently controlled on the occasions upon which they did attend.

With regard to the incidence of degenerative changes, we found that 72 per cent. of the patients with retinopathy were defaulters, and that, of the 34 patients who were free from any sign of degenerative disease, only six were defaulters.

Although this group of cases is too small to enable one to draw definite conclusions, the findings in regard to " defaulters " certainly suggest that truly strict control of the diabetic state might lessen the incidence of degenerative changes. On the other hand, there is no doubt that in certain cases the disaster of haemorrhage into the vitreous occurs as a vascular accident in patients with only a few retinal haemorrhages, and may do so even in patients with perfectly controlled diabetes.

Capillary Fragility

There seems to be little doubt that capillary fragility is increased in a large proportion of patients with diabetic retinopathy. For example, Barnes (1950), in an analysis of 220 diabetics, found that, of eighty patients with retinal changes, 85 per cent. had increased capillary fragility. The average duration of the diabetes, in these cases, was 17·2 years. On the other hand, he found that oral administration of rutin, over long periods, had little effect in improving either capillary fragility or retinal changes.

In Edinburgh, we have found no evidence that rutin is of any practical value; though it might be worth while trying to control the increased capillary fragility in juvenile diabetics, before they have developed retinopathy, to see if such measures would prevent changes which one certainly cannot cure once they have become established.

Changes in Refraction

Horner (1873) drew attention to the sudden changes in refraction which might occur in diabetics. There is certainly no doubt that the alteration in refraction is due to changes in the lens. Elschnig (1923) reported a case in which the patient had previously had a cataract removed from one eye, and in whom these changes in refraction affected only the remaining lens.

As suggested by Duke-Elder (1925), it is probable that hydration of the lens by osmotic influences explains the mechanism of the change in most cases.

With a rising blood-sugar, provided the water-balance of the body is reasonably maintained, the effective osmotic pressure of the tissue-fluids tends to fall owing to a loss of salts. The heavy loss of salt in the increased excretion of urine is not adequately replaced, although the bulk of fluid is made up by drinking water. The lowered osmotic pressure of the aqueous thus determines an inflow of water into the lens.

On the basis of the theory put forward by Duke-Elder, one can certainly explain the vast majority of cases in which transitory myopia develops with a rising blood-sugar, and in which the condition is reversed when the diabetes is treated. It is the sudden change to hypermetropia, soon after the commencement of treatment, which often worries the patient who suddenly becomes unable to read.

The points of practical importance are, firstly, to recognize that the sudden onset of myopia may be a sign of unsuspected diabetes, and secondly, to reassure the patient in whom hypermetropia suddenly develops when the disease is being treated. It is also important not to order any change of glasses for the latter disturbance, until 3 or 4 weeks have elapsed, during which time the refractive state of the eyes should have become stabilized.

While most cases can be explained on the theory expounded by Duke-Elder, there are those like that of Graham and Oakley (1938), in whom the reverse occurs, and the patient becomes less hypermetropic, or myopic, as the diabetic state is controlled. I have, myself, seen one or two similar cases, but these are exceptions to the general rule.

Cataract in Diabetes

True diabetic cataract, which is bilateral and often develops quickly, tends to occur in young patients with severe diabetes. This condition is relatively rare: the development of senile cataract is a problem of more practical importance though it seems no more common in diabetics than in non-diabetics in a similar age group. This view is supported by the findings of Waite and Beetham (1935), who found the incidence of senile cataract (2,000 diabetics) no greater than in non-diabetics of a comparable age.

On the other hand, my own impression is that senile cataract matures more quickly in the diabetic than in the non-diabetic patient.

Provided the diabetic with senile cataract has no other complications, such as retinopathy or change in the vessels of the iris, to which I shall refer later, the immediate result of operation is just as good, in my experience, in the diabetic as in the non-diabetic patient.

Bleeding from the iris is certainly more common in diabetics than in normal patients. On the other hand, my own experience is the same as that of De Voe (1942) who found that the presence of diabetes did not greatly alter the ultimate prognosis, although it might prolong the period of convalescence.

The most serious post-operative complication which may occur is that of iritis or iridocyclitis which may be severe and intractable. For this reason,

it is, I think, of particular importance, before operating upon diabetic patients, to exclude, as far as possible, any focus of infection in, for example, the teeth, nasal sinuses, or renal tract.

Philps (1940) has recommended that, in diabetics, the iris should be interfered with as little as possible in order to minimize post-operative bleeding and I certainly agree with this recommendation where there is any sign of congestion or of new-vessel formation in the iris tissue. If, however, the iris appears healthy, then my own view is that it is more important to try to ensure that the lens is extracted without breaking the capsule, even if, in cases with a rigid pupil, it means doing a complete iridectomy. Just as the diabetic seems to be unduly susceptible to small foci of endogenous infection, severe post-operative iritis may be precipitated by remnants of lens material.

Apart from making a thorough search for possible foci of infection, the pre-operative care of the diabetic patient mainly devolves, as Kirby (1941) has emphasized, into the problem of getting the patient into the best possible state of general well-being.

This may involve a short period of observation before operation, with adjustment of the diet and insulin requirements to ensure that glycosuria is reduced to no more than a trace. On the morning of operation, the patient should be given a light carbohydrate breakfast with or without a small dose of soluble insulin. After operation, one should prescribe a light diet of approximately the same carbohydrate content as before operation, with enough insulin to avoid hypoglycaemia on the one hand, and marked hyperglycaemia on the other. As in the case of the non-diabetic, the diet should be such as to avoid unnecessary mastication.

Other Ocular Complications

The remaining ocular complications, are either rare, not amenable to treatment, or both.

Ocular Palsies.—Palsy of the external rectus is the commonest and recovery is the rule.

Amblyopia.—Although cases of chronic bilateral optic neuropathy have been described as occurring in diabetes, it is, as Walsh (1947) has suggested, extremely doubtful if there is such a thing as true diabetic optic neuritis. Certainly Waite and Beetham (1953) in their review of 2,000 diabetics did not encounter one case.

On the other hand, I have seen a number of cases of tobacco amblyopia develop during a phase of incomplete control of the diabetic state, and resolve completely, without cessation of smoking, as soon as control was regained. I have one patient, a heavy smoker, who develops such amblyopia periodically. If his period of poor control is prolonged, he cures his tobacco amblyopia by stopping smoking, but if he recovers control rapidly his amblyopia disappears without any alteration in his smoking habits.

As I have recently emphasized (Scott, 1953), bilateral toxic amblyopia

in a diabetic patient should always arouse suspicion of the possibility of tobacco poisoning in a patient who smokes a pipe or cigars.

Rubeosis of the Iris.—This condition, in which there is a proliferation of new vessels in the iris, is rare but of serious significance, since it is always followed by glaucoma and is not amenable to operative treatment.

Summary

Retinopathy.—There is now no doubt that diabetic retinopathy is an entity quite distinct from that occurring as a result of hypertension. The findings in 150 diabetics, all of whom have had the disease for periods varying from 15 to 26 years, are discussed.

It seems to be generally agreed that incidence increases with the duration of the diabetes, and that it is in no way connected with the severity of the disease. The longer expectation of life for the diabetic since the introduction of insulin, means that retinopathy and other vascular changes now occur in the young as well as in the old, and have created a problem which can only be solved by intensive research.

The various stages in the development of the retinal changes are classified from a clinical point of view. In an appreciable number of cases, in the region of 10 to 16 per cent. of those with retinal changes, sudden haemorrhage into the vitreous may occur, and this will inevitably be followed by proliferative changes. It is emphasized, however, that, even in the presence of retinal changes, good visual acuity may be retained for many years.

The effect of " control " of the diabetic state, upon the incidence and course of the retinal changes, is discussed. The view is expressed that this all-important problem requires further investigation, but that it seems probable that the retinal and other degenerative vascular complications might be lessened by truly strict control of the diabetic state.

Transient Changes in Refraction.—The occurrence and clinical significance of such changes is described.

Cataract.—The effect of diabetes upon the incidence and development of senile lens opacities is discussed, as well as certain points in the pre-operative care of the diabetic patient.

Other Complications.—The rarer conditions, such as toxic amblyopia, palsy, and rubeosis, are briefly considered.

REFERENCES

ASHTON, N. (1949). *British Journal of Ophthalmology*, **33**, 407.
——— (1951). *Proc. roy. Soc. Med.*, **44**, 747.
BALLANTYNE, A. J., and LOEWENSTEIN, A. (1943). *Trans. ophthal. Soc. U.K.*, **63**, 95.
BARNES, R. H. (1950). *Amer. J. med. Sci.*, **219**, 368.
CROOM, J. H. (1950). *Edinb. Med. J.*, **57**, 185.
——— and SCOTT, G. I. (1949). *Lancet*, **1**, 555.
DEVOE, G. (1942). *Arch. Ophthal., Chicago*, **28**, 1069.
DUKE-ELDER, S. (1925). *British Journal of Ophthalmology*, **9**, 167.
ELSCHNIG, A. (1923). *Med. Klin.*, **19**, 17.
GRAHAM, G., and OAKLEY, W. G. (1938). *St. Bart's Hosp. Rep.*, **71**, 43.
HANUM, S. (1939). *Acta ophthal., Kbh.*, Suppl. 16.

HORNER, J. F. (1873). *Klin. Mbl. Augenheilk.*, **11**, 488.
JOSLIN, E. P., ROOT, H. F., WHITE, P., MARBLE, A., and BAILEY, C. C. (1946). "Treatment of Diabetes Mellitus", 8th ed. Kimpton, London.
———, ———, ——— (1952). *Ibid.*, 9th ed.
KIMMELSTIEL, P., and WILSON, C. (1936). *Amer. J. Path.*, **12**, 83.
KIRBY, D. B. (1941). *Arch. Ophthal., Chicago*, **25**, 866.
LAWRENCE, R. D. (1951). *Proc. roy. Soc. Med.*, **44**, 742.
MACKENZIE, S. (1877). *Roy. Lond. ophthal. Hosp. Rep.*, **9**, 134.
MYLIUS, (1937). *Klin. Mbl. Augenheilk.*, **98**, 377.
NETTLESHIP, E. (1877). *Roy. Lond. Ophthal. Hosp. Rep.*, **9**, 153.
PHILPS, A. S. (1940). *British Journal of Ophthalmology*, **24**, 122.
SCOTT, G. I. (1951). *Proc. roy. Soc. Med.*, **44**, 743.
——— (1953). *Practitioner*, **170**, 480.
WAGENER, H. P. (1945). *Proc. amer. Diabetes Ass.*, **5**, 203.
——— and WILDER, R. M. (1921). *J. amer. med. Ass.*, **76**, 515.
WAITE, J. H., and BEETHAM, W. P. (1935). *New Engl. J. Med.*, **212**, 367.
WALSH, F. B. (1947). "Clinical Neuro-Ophthalmology", 1st ed. Williams and Wilkins, Baltimore.
WILSON, J. L., ROOT, H. F., and MARBLE, A. (1951). *Amer. J. med. Sci.*, **221**, 479.

Brit. J. Ophthal. (1953), **37**, 716.

OCULAR COMPLICATIONS OF DIABETES MELLITUS*

BY

LEONARD H. HOWELLS

United Cardiff Hospitals

A GENERAL review of the more important aspects of diabetes mellitus is desirable before proceeding to a consideration of the particular problem of the ocular complications.

Diabetes mellitus, already a common disease, is likely to become more common in the future. It has been estimated that in the United States of America there are about 1 million diabetics and probably another million undiscovered, and in the United Kingdom the number has been variously estimated at different times from 33,000 (Stocks, 1949) to 200,000 (Joslin, and others 1946). In Cardiff there are two diabetic clinics, one at the Royal Infirmary, and the other at the City Council Health Centre. Approximately 1,200 attend these clinics, and of these, six hundred reside within the boundaries of the city, which, with an estimated population of 250,000, gives an incidence of 240 cases of diabetes per 100,000 of population, this figure being comparable with that obtainable in other parts of the country. No fewer than 268 new patients were seen during 1952, and approximately six to eight new patients seek advice each week. These figures refer only to those attending the clinics, and there must be many others who do not attend or who are as yet undiscovered.

The disease is becoming more common for a variety of reasons. Firstly, it is a hereditary disease and is transmitted as a Mendelian recessive. Secondly, since the discovery of insulin, there has been an increase in the fertility of diabetics, a reduction in the incidence of maternal mortality, and an improvement in the foetal survival rate. It has been estimated, for example, that for every 282 pregnancies, there is one diabetic pregnancy, whilst the maternal mortality has been reduced to between 2 and 9 per cent. (Gilbert and Dunlop, 1949). Thirdly, diabetics are living longer and, if properly controlled, may live almost as long as non-diabetics. This is mainly due to insulin therapy, but improved dietary control and the advent of chemotherapy, antibiotics, and anticoagulants play an important part. It has been estimated that a child developing diabetes mellitus at age 10 had an expectation of life of 2·6 years in 1922 as compared with one of 39·8 years in 1938; comparable figures for a young adult are 6·3 years in 1922 and 27·6 years in 1938.

Factors influencing the Development of Diabetes.—Although the probable cause of diabetes mellitus is a degeneration of the beta cells of the islets of Langerhans in the pancreas, the exact cause is not known; there are, however, a number of factors which influence its development, and a proper appreciation of these should

*Received for publication July 7, 1953.

help to reduce the incidence of the disease and consequently of the development of retinopathy. These factors are:

(1) *Hereditary Transmission.*—Diabetics who marry other diabetics or marry those with a family history of the disease, should be warned of the probability or possibility of their offspring acquiring the disease, or of transmitting the strain.

(2) *Infections and Sepsis.*—These usually exert a temporary adverse influence upon the course of the disease, and in many cases act as a precipitating factor in its development. They are of special significance in causing diabetic retinitis, as shewn by Ballantyne (1946), who found them a factor in 35 out of 561 cases of diabetic retinopathy.

(3) *Obesity.*—It is firmly established, both by life insurance company statistics and by clinical studies on both sides of the Atlantic, that this is a most important factor in the middle-aged and elderly, particularly when there is a predisposition to the disease. There is no doubt that diabetes may be avoided in at least a proportion of the population if it is appreciated that consistent overeating will result in a sustained increased demand for insulin, which may so over-tax the pancreas that it will fail and result in the development of diabetes.

(4) *Disorder of other Endocrine Glands.*—This, especially in the thyroid and pituitary glands, may be associated with diabetes mellitus, which usually responds favourably when the other endocrine disorder has been corrected.

(5) *Tobacco.*—Elderly diabetics are said to be especially liable to develop tobacco amblyopia (Joslin and others, 1946). There is no evidence that diabetic retinopathy is related to the blood level of cholesterol, urea, or calcium, or to the presence of acidosis or ketosis (Lawrence, 1951; Ballantyne, 1946).

Diagnosis.—Although the classical symptoms of the disease usually cause the patient to seek advice, in some the discovery of diabetes may be entirely fortuitous during routine testing of the urine for various purposes. When the presence of the disease is suspected, it is usually sufficient to obtain a single blood sugar estimation to establish the diagnosis, but if this result is inconclusive, a full glucose tolerance test must be obtained.

Clinical Types

Mild Diabetes.—The disease is usually mild when it appears for the first time between the ages of 40 and 65. In such cases, it usually causes pruritis, retinitis, gangrene, neuritis, and loss of weight, whilst ketosis and coma are practically unknown. The patients are usually insulin sensitive, and either need very little insulin or respond well to dieting alone.

Severe Diabetes.—Although the disease in a severe form may affect all ages, it is especially liable to occur in those under the age of 20 or over 65 years. The classical symptoms of thirst, polyuria, lethargy, and loss of weight are usually present, and if they are untreated, ketosis and coma result. Such patients are usually insulin resistant, and are rarely controlled without large doses.

Clinic Arrangements in Cardiff

It must be accepted that control of the disease and care of the diabetic patient are essential. Whilst this can be effected in most patients by attendance at a clinic, all young diabetics and those with ketosis should be treated first in hospital.

In Cardiff we have the active support of the City Council, who provide and maintain an " after care " clinic to which patients are referred after investigation and

stabilization at the hospitals. This excellent arrangement not only ensures periodic supervision of the patient, but saves appreciably the occupancy of hospital beds by diabetics. The clinic is supervised by a consultant physician and the Medical Officer of Health, assisted by a registrar, dietitian, health visitors, chiropodist, and cookery demonstrators. A most valuable feature of the service is the domiciliary contact by the health visitors, who thus ensure regular attendance at the clinic of would-be defaulters, and who give valuable advice to those in difficulty.

Control by Diet and Insulin

In the obese diabetic, the aim should be a reduction in weight by means of a low calorie diet to the calculated ideal weight for the patient. The very obese should be given a 1,000 calorie diet, the less obese a 1,500 calorie diet, containing about 120–150 g. carbohydrate each day. As many patients will find this regime difficult to follow, it is often desirable to prescribe a supportive drug, the most suitable being dextro-amphetamine sulphate 5–10 mg. before breakfast and before lunch. Although this drug will not of its own accord cause a loss of weight, it will enable the patient to control the demands of his appetite, and will remove depression and fatigue, and promote physical and mental alertness. It is relatively non-toxic and is safe to use except when there is a history of coronary arterial disease or when severe anxiety or insomnia are present.

It is a mis-application of treatment to prescribe insulin initially to overweight patients, for experience shows the great importance of reducing weight, and the administration of insulin will promote an increase in weight. Insulin therapy will be required for all patients with severe diabetes, particularly the young and elderly, and in those who are underweight and have definite symptoms or ketosis. A diet suitable for the patient's requirements is prescribed individually, taking into account his particular circumstances and tastes, and instructions are given on food exchanges, general care of the health, and the technique of insulin administration. In most cases a combination of soluble insulin and protamine zinc insulin is prescribed, but in the more severe type, or when meals cannot be taken regularly, it is preferable to employ soluble insulin twice or thrice daily. The dose will be a matter for precise assessment in each individual and will require variation from time to time.

If coma threatens, a search for a focus of infection should be made, solid food should be replaced by 3-hourly liquid feeds, each of about 24 g. carbohydrate, the urine should be tested every 3 hours, and soluble insulin given at these times in doses determined by the amount of sugar found in the urine.

Surgery and Choice of Anaesthetic

When a local anaesthetic is used, the normal routine should not be changed. If an anaesthetic of short duration is required, very little alteration need be made, but it is important to give the usual dose of insulin with an additional 50 g. carbohydrate in liquid form 2 hours before the operation. In major surgical procedures, it is wise to delay the event if possible till ketosis has been abolished. The general principle should be to maintain the normal routine for as long as possible and to give 50 g. glucose with the usual dose of soluble insulin 2 hrs before the operation. Afterwards, an intravenous drip containing 5 per cent. glucose in saline should be set up and the regime recommended for the pre-coma case instituted. The normal routine should be resumed as soon as possible.

Anaesthetics that induce vomiting or are toxic to the liver should be avoided. Thus ether and chloroform are not suitable, whilst thiopentone, nitrous oxide and oxygen, and cyclopropane are suitable.

Diabetic Retinopathy

A detailed consideration of the changes seen in diabetic retinopathy must be left to others more competent than I, and my remarks here will be confined very largely to general observations. It is disappointing for the physician to save young diabetics from coma and subsequently to help them to maintain a good standard of physical health only to find that years later they develop serious degenerative vascular diseases of which retinopathy is a very important and only too common example. It is not too much to claim that its prevention is the most important and challenging problem in the management of diabetes. Ocular complications are frequent and distressing and are becoming more common because of the increasing longevity of diabetics. Formerly not seen in the young because they succumbed to the disease at an early age, it now affects them in middle life or later. Apart from the humanitarian aspect, it is also an important economic problem, particularly when one considers that diabetics are often above average in intelligence, and because of their affliction are influenced to take up occupations of a clerical, professional, or skilled nature. It is particularly distressing that retinopathy is often seen even in those whose cases are classified as mild and well-controlled. It thus follows that it is all the more important to concentrate on prevention, paying attention to the factors known to influence the development of diabetes (*e.g.* heredity, obesity, sepsis, hyperthyroidism) and giving advice on their avoidance whenever possible.

Statistics show that diabetic retinopathy usually appears in those with long-standing diabetes, 10, 15, 20, 25 years, or more after the onset of the disease. The highest incidence thus falls in the middle-aged or elderly, although it is sometimes seen in the young. The proportion of diabetics affected varies according to age group, a reasonable average being about 30 per cent. of all diabetics. Higher proportions are found in older people; for example, retinopathy is found in 40 to 50 per cent. in the age group 60–70 years, and some writers claim an incidence of 70 and even 100 per cent.

Many claim that recent advances in treatment do not protect against the development of retinopathy, and that it is found as frequently in mild and clinically controlled cases, even in those taking insulin, as in severe or uncontrolled cases. These observers claim that what matters most is the duration of the diabetes, and that insulin has no influence in preventing the development of retinopathy (Saskin and others, 1951; Ballantyne, 1946). There are others, however, who maintain that proper and sustained attention to diet, regular supervision, and control of hyperglycaemia and glycosuria have an important influence in preventing the development of retinal changes. (Lawrence, 1951; Scott, 1951; Wilson and others, 1951; Joslin and others,

1952). Joslin, in particular, states that if young diabetics are taught properly how to manage their disease, complications need never develop, and to further this object he has advocated the construction of suitable diabetic camps or homes or special hospitals with proper facilities. As explained above, a special "after care" clinic supported by health visitors, etc., has been fulfilling this important function in Cardiff. Whatever one's personal views on the influence of treatment, it would be foolish to ignore the importance of proper and adequate control of diabetes, particularly with regard to diet.

It is necessary to refer to the influence of hypertension in relation to the development of retinopathy. In general it may be stated that most authorities agree that diabetic retinopathy is independent of and distinguishable from the effects of arteriosclerosis and hypertension (Ballantyne, and Loewenstein, 1943; Ballantyne 1946; Lawrence, 1951; Scott, 1951; Bedell 1939; Joslin and others, 1946). It is well recognized, however, that in the later stages retinal changes characterized by hypertension may be superimposed on those due to diabetes, and that in advanced cases it may be impossible correctly to apportion the blame.

Retinitis proliferans is known to occur as a late complication of diabetic retinopathy in long-standing cases, the retinal changes being accompanied by severe damage to the kidneys and also hypertension. Similar pathological lesions are found in the retinae and glomeruli of the kidneys. In retinitis proliferans, the prognosis is hopeless as regards vision and is grave as regards life, the majority affected dying at an early age from anaemia or cardiac failure. The disease is associated with albuminuria in two-thirds of the cases and with arteriosclerosis and hypertension in the majority. Although many young diabetics are affected, more than 50 per cent. of cases occur after 50 years of age.

Kimmelstein-Wilson disease is also one which occurs in long-standing diabetics, and is also characterized by renal and retinal lesions resulting in early death from renal or cardiac failure, and also in blindness. An associated lesion is an intercapillary glomero-sclerosis.

Apart from these two specific diseases, diabetic retinopathy may be complicated by the onset of renal failure from other causes or by hypertension and arteriosclerosis.

The fundus picture in diabetes is progressive and the prognosis with regard to vision in diabetic retinopathy is bad in the extreme. (Ballantyne and Loewenstein, 1943; Ballantyne, 1946). There are some, however, who claim a more favourable prospect with the exception of advanced degrees of retinitis proliferans and Kimmelstein-Wilson disease (Lawrence, 1951; Whittington, 1951; Joslin and others, 1946). It is generally agreed that the fundus changes are no guide to life expectancy.

As already indicated, I will leave the detailed consideration of the fundus picture to others, except to mention briefly that the whole course of development, beginning with the appearance of micro-aneurysms, followed by dot

and blot haemorrhages, wax exudates, and phlebosclerosis, and later by haemorrhages in the vitreous and destruction of the retina, represents one progressive process. The exact cause is a matter for speculation, but since diabetes is a common factor in all cases it seems logical to conclude that some toxic change peculiar to this disease must play an important part.

It is claimed that rutin has a beneficial effect upon retinal haemorrhages (Levitt and others 1948), but in several cases in which this treatment has been tried in our clinics, the results have not been at all impressive. It has also been claimed that testosterone therapy will produce an unequivocal improvement in 30 per cent. and improvement in another 40 per cent. of cases (Saskin and others, 1951); I have had no personal experience of this form of therapy, and the absence of any further reference to it in the literature suggests that it has not been received with marked favour.

In addition to the retinal changes occurring in diabetes, cataracts often develop in long-standing and especially in untreated cases. These may be caused by the high sugar content of the eye, but on the other hand, the incidence of cataracts in non-diabetics is quite as high as in diabetics. Temporary changes in accommodation causing either myopia or hypermetropia may result from changing refraction due to varying sugar content, particularly in those receiving insulin.

Retrobulbar neuritis and diplopia occur occasionally, and more rarely lipaemia retinitis, optic tract lesions, optic atrophy, and paralysis of the ocular muscles may be encountered.

Present Series of Cases

There are about 1,200 diabetics attending the clinics in Cardiff, and for the purpose of this investigation, one hundred of these patients were taken at random and submitted to a detailed examination with special reference to fundus changes.

An analysis of the fundus appearances is tabulated in Table I, from which it will be seen that 34 cases were considered to have diabetic retinopathy; as no view of the fundus could be obtained in seven patients, this gives an incidence of 37 per cent. The detailed changes observed in the fundi of these 34 patients are recorded in Table II (overleaf), which shows the appearances to be fairly typical of diabetic retinopathy in 25 patients, and rather more typical of retinitis proliferans in nine patients.

TABLE I

FUNDUS APPEARANCES IN 100 UNSELECTED CASES OF DIABETES MELLITUS

No view of either fundus	7
Non-diabetic abnormalities	3
Normal	27
Slight vascular changes not definitely diabetic	29
Diabetic retinopathy	34

The correlations between the clinical findings and the occurrence of diabetic retinopathy in the whole group of 93 patients in whom a good view of the

TABLE II

CHANGES SEEN IN FUNDI IN 34 CASES OF DIABETIC RETINOPATHY

Punctate haemorrhage ...	without vascular changes	9
	with slight to moderate venous changes	2
	with hard exudates...	2
	with exudates and vascular changes	12
Hard exudates	with gross vascular changes	1
	with gross vascular changes and large haemorrhage ...	3
	without vascular changes or large haemorrhage ...	1
Large haemorrhage with moderate vascular changes	without exudates	1
	with exudates	3

fundus was obtained and an analysis of the 34 cases with diabetic retinopathy is given in Table III, from which some interesting facts emerge:

TABLE III

CORRELATION OF CLINICAL GROUPS WITH DIABETIC RETINOPATHY

Clinical Group		Total No. of Patients	Diabetic Retinopathy Present		
			No. of Patients	Percentage of Total	Percentage of 34 Patients with Retinopathy
Good view of fundus		93	34	37	100
Age at examination	Under 40 years	18	1	6	3
	40 – 60 years	37	10	27	30
	Over 60 years	38	23	60	67
Age at onset of disease	Under 40 years	29	5	17	15
	40 – 60 years	45	18	40	53
	Over 60 years	19	11	58	32
Duration of disease	Under 10 years	69	23	33	67
	10 – 20 years	18	8	44	24
	Over 20 years	6	3	50	9
Disease well controlled	Yes	51	21	41	62
	No	42	13	33	38
Blood pressure	Normal	44	9	20	26
	Moderate (170/90)	25	9	36	26
	Severe (200/105)	24	16	66	47
Albuminuria present		16	10	62	30
Reflexes in knees and ankles absent ...		14	11	71	32
Family history of disease		28	10	34	30

(1) The incidence of diabetic retinopathy in an unselected group of diabetic patients is 37 per cent.

(2) The incidence of diabetic retinopathy increases markedly with increasing age at the time of examination.

(3) A similar but less striking trend is noted when incidence is related to age at onset.

(4) When the incidence of diabetic retinopathy is related to the duration of the diabetes mellitus it is found to be very little higher in the longest group than in the shortest. When the duration of the disease is analysed in the 34 patients with diabetic retinopathy, no less than 67 per cent. had had the disease for less than 10 years, only 9 per cent. having had it for 20 years, and the remaining 24 per cent. falling into the 10-to-20-year group. These figures indicate that the actual duration of the disease is not so important as might be thought.

(5) There is a higher incidence of diabetic retinopathy in patients with well controlled diabetes than in those not so well controlled.

(6) The incidence of diabetic retinopathy increases with a rise in blood pressure.

(7) Of patients with albuminuria, no less than 62 per cent. have retinopathy, and the incidence of albuminuria amongst those with retinopathy is 30 per cent.

(8) Of those with absent reflexes in the lower limbs, 71 per cent. have retinopathy, and in 32 per cent. of 34 patients with retinopathy lower limb reflexes were absent.

(9) The incidence of retinopathy was 34 per cent. amongst those with a family history of diabetes, and 30 per cent. of patients with retinopathy had a family history of diabetes.

Summary

In the development of diabetic retinopathy, the age of the patient is what matters most, the incidence of this complication being highest in the oldest age group whether the age is calculated from the time of examination or from the time of onset of diabetes. High blood pressure, albuminuria, and neuropathy are commonly found in cases of diabetic retinopathy, and, as might be expected, in the unselected cases, the incidence of retinopathy is highest amongst those showing these abnormalities.

The duration of the disease is of some importance, but there is little variation in the incidence of retinopathy in the under-10-year group as compared with the 10-to-20 and over-20-year groups of unselected patients; the surprising fact emerges, however, that, of those with retinopathy, no less than 67 per cent. were found in the under-10-year group as compared with 24 per cent. in the 10-to-20-year group and 9 per cent. in the over-20-year group.

The most disappointing feature of this analysis is that the incidence of retinopathy is higher in the group of controlled diabetes than in the less well controlled group.

I am indebted to Dr. G. Vine Cole for examining and reporting on the eyes, and to Dr. E. Rhys Jones, for a detailed clinical examination and providing me with a careful analysis of the findings.

REFERENCES

BALLANTYNE, A. J. (1946). *Trans. ophthal. Soc. U.K.*, **66**, 503.
———, and LOEWENSTEIN, A. (1943). *Ibid.*, **63**, 95.
BEDELL, A. J. (1939). *Ibid*, **59**, 219.
GILBERT, J. A. L., and DUNLOP, D. M. (1949). *Brit. med. J.*, **1**, 48.
LAWRENCE, R. D. (1951). *Proc. roy. Soc. Med.*, **44**, 742.
LEVITT, L. M., CHOLST, M. R., KING, R. S., and HANDELSMAN, M. B. (1948). *Amer. J. med. Sci.*, **215**, 130.
JOSLIN, E. P., ROOT, H. F., WHITE, P., MARBLE, A., and BAILEY, C. C. (1946). "The Treatment of Diabetes Mellitus", 8th ed. Kimpton, London. (see also *Lancet* (1952), **2**, 1073).
SASKIN, E., WALDMAN, S., and PELNER, L. (1951). *Amer. J. Ophthal.*, **34**, 613.
SCOTT, G. I. (1951). *Proc. roy. Soc. Med.*, **44**, 743.
STOCKS, P. (1949). "Sickness in the Population of England and Wales in 1944–1947". Studies in Medical and Population Subjects, No. 2, p. 42. General Register Office. H.M.S.O., London.
WHITTINGTON, T. H. (1951). *Proc. roy. Soc. Med.*, **44**, 753.
WILSON, J. L., ROOT, H. F., and MARBLE, A. (1951). *Amer. J. med. Sci.*, **221**, 479.

Brit. J. Ophthal. (1953), 37, 725.

LENS EXTRACTION IN DIABETIC PATIENTS*†

BY

A. B. NUTT

Sheffield

The operative and post-operative course of diabetics is no worse than that of normal persons, if they are without hyperglycaemia and acetonuria

THIS is a quotation from a recent and excellent textbook on ocular surgery. It is a view with which I felt I could not agree, and I therefore decided to review a series of cases of patients suffering from diabetes and undergoing operation for cataract. Undoubtedly the use of insulin has improved the prognosis in these cases, but, in my opinion, the eye of a diabetic patient should not be considered a normal eye when it comes to operation— there is more likelihood of a stormy convalescence and less chance of a good result than in a patient not suffering from diabetes.

The discovery of insulin has been one of the most important advances in medicine during the last 50 years. It has completely altered the prognosis in diabetes. The young diabetic is growing up and leading a normal life. I have one young patient whose diabetes was discovered when he was 3 years old; to-day at the age of 20 he is well on the way to qualifying as a solicitor. Another patient—a stockbroker 32 years old—has suffered from diabetes since childhood and thanks to insulin has not only conducted his business affairs with considerable success, but has also played active games until recently, when he was obliged to curtail his activities on account of failing sight. These patients both have diabetic cataract and will require operation fairly soon. I mention them because in the pre-insulin days they would have died long ago, and there would have been no problem with regard to operation. Older patients too are surviving for many years, and undoubtedly more patients suffering from diabetes come to operation on the eyes than in the days before 1921.

Prognosis in Pre-Insulin Period

The outlook as regards operation on the eyes of diabetic patients before that date is interesting. As one would expect, the incidence of diabetes among cases operated on for cataract was relatively small; *e.g.* there were only 87 cataract extractions (5·2 per cent.) in diabetics out of a total of 1,660 cases collected by Gray Clegg (1920) and of these only eight shewed definite signs of diabetes—loss of flesh, polyuria, and polydipsia. This method of assessing the case is rather a contrast to the years following 1920 when blood sugar estimations and so on became the criteria of true diabetes as opposed to renal glycosuria.

*Received for publication August 10, 1953.

† Given at the B.M.A. Annual Meeting, Cardiff, 1953.

The prognosis in cases of diabetes operated on for cataract was by no means a happy one; of Gray Clegg's 87 extractions, 28 developed hyphaema which remained for anything up to 27 days, iritis occurred in 26 cases in eleven of which it was severe, hypopyon was noted in two, and there were two deaths in coma after operation.

The only pre-operative precaution taken was restriction of carbohydrate intake. The outlook was distinctly gloomy and doubtless in those days ophthalmic surgeons were very cautious in advising operation on patients suffering from diabetes.

Even so, in the course of the same discussion James (1920) reported four cases in relatively young people all suffering from true diabetes (ages 22, 37, 36, 35) where satisfactory results were obtained in four out of 5 eyes. James made a special point of admitting the patients to hospital and having them treated by a physician until a marked fall in the sugar output had taken place; he was then ready to operate if the patient desired him to do so.

Prognosis at the Present Time

The position to-day presents a marked contrast. Reviewing the cases of diabetes operated upon in the Ophthalmic Department of the Sheffield Royal Infirmary during the last 5 years, I had in mind four problems:

(1) Wound healing.
(2) Incidence of infection.
(3) Incidence of bleeding.
(4) Incidence of iridocyclitis.

For purposes of comparison, I took fifty consecutive cases of lens extraction on " normal " patients and compiled the Table (opposite) in an attempt to shew the incidence of post-operative complications in each series.

In making the survey I was impressed by two things; first, the small number of patients suffering from diabetes admitted for operation during the period under review (30), and secondly the high proportion of cases, some of them with a known retinopathy and others with severe hypertension, who survived operation with a minimum of post-operative convalescence and with good visual results. These good results must be attributed partly to careful stabilization of the diabetes before operation and partly to advances in operative technique.

Wound Healing.—This is not a major problem to-day and one finds it difficult to believe that it ever was so, but France (1858), in a discussion on cataract in association with diabetes wrote that " his experience would lead him strenuously to deprecate any operative interference so long as a useful degree of vision is preserved ", and he based his opinion chiefly on the indisposition of the cornea in such cases to heal even the minutest wound inflicted by a needle, and this applied more so in regard to a linear extraction: the operation which he favoured was keratonyxis, which from its derivation κέρας (cornea) νύσσειν (to puncture) was the equivalent of the modern procedure of needling or discission.

That it is not a problem to-day is due to several factors in addition to the over-

TABLE

Cases	Visual Acuity	No. of Cases	Post-operative Complications		Remarks
			No.	Description	
Normals	6/6	14	None		None
	6/9	16	None		None
	6/12	2	None		None
	6/18	6	2	Iridocyclitis	None
	6/24	1	1	Vitreous loss at operation followed by iridocyclitis	None
	6/36	3	1	Iridocyclitis	Macular changes 2
	6/60	1	None		Macular changes 1
	C.F.	4	None		Macular changes 4
	P.L.	1	1	Iridocyclitis	None
	Eyes lost	1	1	Iridocyclitis with secondary glaucoma	Enucleated—painful eye
	Died	1			
	Total	50	6		
Diabetics	6/6	5	None		None
	6/9	16	5	Iridocyclitis 3 Hyphaema 1 Delayed wound healing 1	Retinopathy 2
	6/12	1	1	Hyphaema with vitreous haemorrhage	Cleared
	6/18	1	None		Retinopathy
	6/36	1	1	Vitreous loss with mild iridocyclitis	None
	C.F.	1	None		Advanced retinopathy
	P.L.	1	1	Iridocyclitis with hyphaema	None
	Eyes lost	4	4	Intractable iridocyclitis with hyphaema	None
	Total	30	12		

One case left town—probably bad result . . . . iritis.

riding principle of careful pre-operative stabilization of the patient and the use of insulin—*viz.* careful asepsis using the no-touch technique—the use of the antibiotics and chemotherapy when necessary, the routine administration of vitamin C (on which I have more to say later), and careful suturing of the wound. The last is of great importance in two respects: it favours rapid repair and it helps to prevent post-operative bleeding. Most surgeons I think, now suture their cataract cases: the method matters little provided that there is accurate apposition of the margins of the wound and that it is effected with a minimum of trauma to the tissues.

Infection.—This is now a most unusual complication, but if it should occur, the use of chemotherapy and the antibiotics is a great help, and thanks to polymyxin the dreaded *Ps. pyocyaneus* can be controlled.

Bleeding.—Generally speaking, diabetic patients are more likely to bleed than normal persons of the same age, but there is some difference of opinion as to the incidence of haemorrhage after lens extraction: for instance, Marshall (1895)

reported the incidence of post-operative bleeding as nil in thirty diabetic patients in a series of 1,519 extractions, and Wheeler (1916), reviewing a series of 2,123 lens extractions in which 38 of the patients were suffering from diabetes, found an incidence of 29 per cent. in the diabetic cases against 4·5 per cent. in the whole series. He very rightly came to the conclusion that diabetes especially predisposes to post-operative haemorrhage.

In my small series of cases, the incidence of hyphaema following operation was three (10 per cent.), except in association with iridocyclitis (see Table).

Pre-operative investigations on all diabetic patients included a routine report with haemorrhagic diathesis tests from the Haematological Department, and it was borne in mind that anaemia is important in that it may interfere with capillary function.

Normally, after injury, bleeding is arrested in the first place by capillary contraction. If the capillaries are not normal, contraction may not take place and bleeding will not be arrested. It would seem, therefore, to be important to know the state of the patient's capillaries before operation. With this in view two techniques are used which are perhaps not widely known and to which I would like to refer very briefly, *viz.* capillary microscopy and the reaction of capillaries to injury (Macfarlane, 1941).

Capillary Microscopy.—The capillaries at the base of the finger nails are observed through a binocular dissecting microscope. The finger—the index finger appears to be the finger of choice—is supported in a bed of plasticine and a drop of microil placed on the skin at the base of the nail: oblique illumination is used and after a little practice the capillaries can be seen with the 2/3 objective. Three abnormalities are looked for:

(1) increased tortuosity.
(2) gross variation in calibre.
(3) sludging of the blood, *i.e.*, it appears in a somewhat irregular stream—conglomerations of red cells being pushed through the capillaries with each heart beat.

Diabetic patients by and large have more abnormal capillaries than do normal persons of the same age.

Reaction to Injury.—Contractility to trauma can be demonstrated in a normal individual by touching a capillary loop with a fine needle; this causes the capillary to close down rapidly, but this does not occur if the capillaries are abnormal, as they may be in the diabetic patient.

Figs 1 (*a*) and 1 (*b*) show the capillaries of a normal person as seen under the microscope, and one capillary which has contracted down after being traumatized. Figs 2 (*a*) and 2 (*b*) show abnormal capillaries, and the absence of reaction to trauma.

This reaction to trauma is important in regard to haemostasis, the initiation of which is associated with active contraction of the capillaries, the actual clotting of the blood occurring later to maintain the haemostasis thus established. The practical point is that if in a diabetic patient capillary contractility is shown to be abnormal, haemorrhage is likely to persist (*e.g.* from a conjunctival flap or from the vessels in the iris following an iridectomy or iridotomy), so that a corneal section and a simple extraction would be preferable.

The problem is even more difficult in cases of acute congestive glaucoma requiring operation. Here the possibility of using a preparation such as special toluidine blue (BDH) comes to mind (Allen and Jacobson, 1947).

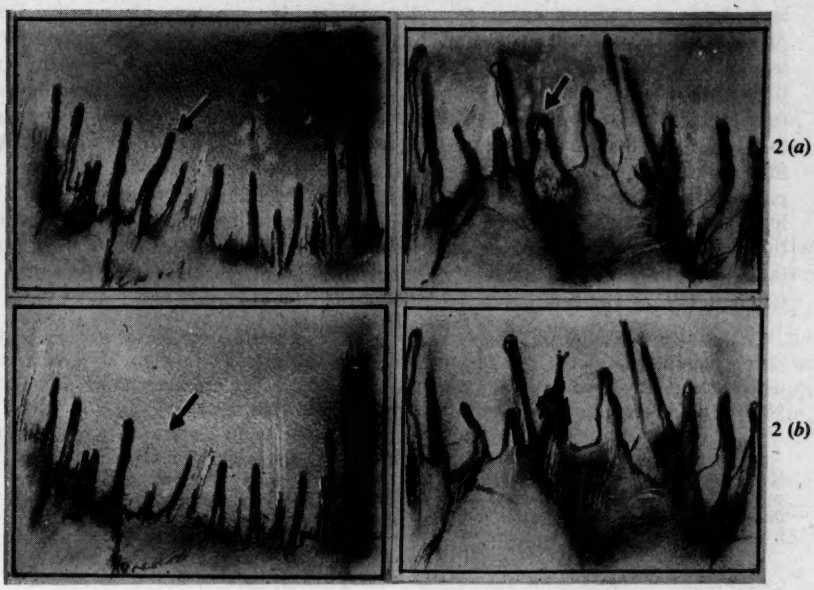

FIG. 1(*a*).—Normal capillary bed.
FIG. 1(*b*).—Same bed showing normal contraction of capillary (arrow) after trauma.

FIG. 2(*a*).—Abnormal capillaries in a case of idiopathic thrombocytopenic purpura.
FIG. 2(*b*).—Same field showing failure of capillary (arrow) to contract after trauma, associated with local haemorrhage.

Vitamin C.—Ascorbic acid is concerned with the synthesis and maintenance of the intercellular material which provides the frame-work for healing, and also with the formation of the intercellular substance of the capillary walls. It is not synthesized in man, nor is it stored to any great extent in the body, and many elderly patients probably have some degree of vitamin C deficiency. It is impossible to do a saturation test on every patient, and the routine, therefore, is to give a daily dosage of 150 mg. empirically to all those admitted for an intra-ocular operation. In passing, I should mention that it is not the level of ascorbic acid in the plasma which matters so much as that in the white-cell layer of the blood. I feel sure that as far as the prevention of bleeding is concerned and also the promotion of wound healing the use of ascorbic acid is valuable in normal patients, and more especially so in diabetics.

Vitamin K.—It seems unlikely that this is of any value in the prevention of post-operative bleeding except in special cases where there is a pathological lesion or the patient is on a deficiency diet for some reason. Provided the diet is suitable there does not appear to be any factor in diabetes to hinder normal absorption of vitamin K from the small intestine.

In the same connection it is worth noting that such preparations as Rutin and vitamin E appear to produce no sustained definite improvement in capillary fragility.

Iridocyclitis.—The Table shows that out of fifty " normal " cases one eye was

lost (2 per cent.) as a result of iridocyclitis with secondary glaucoma. Four (8 per cent.) had iridocyclitis during convalescence but this was only of consequence in one, and one had vitreous loss at operation with subsequent iridocyclitis but finally achieved a visual acuity of 6/24. Of the 31 patients suffering from diabetes, four eyes were lost as a result of intractable iridocyclitis (13·6 per cent.) and four had notable iridocyclitis during convalescence (13·6 per cent.). A comparison of fifty consecutive cases of lens extraction in " normal " patients with thirty-one in patients with diabetes is not statistically sound, for the series is so small that no hard and fast conclusion can be reached, but the figures are suggestive. As regards the avoidance of iridocyclitis, I am sure that the removal of the lens in its capsule is important and that incomparably better results will be achieved if the words of Crichett (1922) are remembered:

> Of this I am well assured, that he will be the most successful operator who accomplishes his purpose in the gentlest possible manner, for in operations on the eye we have to deal with some of the most delicate structures in creation. Let us never forget that Dame Nature is a woman and likes the last word, and always has it.

I wish to express my thanks to Dr. Blackburn of the Haematological Department, Sheffield Royal Infirmary, for his help, to my colleague, Mr. Ferguson, for allowing me to use some of his cases, and to Mr. Foster, Medical Artist of the United Sheffield Hospitals, who has made the diagrams relating to capillary microscopy.

REFERENCES

ALLEN, J. G., and JACOBSON, L. O. (1947). *Science*, **105**, 388.
CRITCHETT, A. (1922). *Trans. ophthal. Soc. U.K.*, **42**, 236.
DE VOE, G. (1942). *Arch. Ophthal., Chicago*, **28**, 1069.
FRANCE, J. F. (1858). *Roy. Lond. ophthal. Hosp. Rep.*, **1**, 273.
GRAY CLEGG, J. (1920). *Trans. ophthal. Soc. U.K.*, **40**, 37.
JAMES, R. R. (1920). *Ibid.*, **40**, 40.
LEVITAN, B. A. (1951). *Amer. J. med. Sci.*, **221**, 185.
MACFARLANE, R. G. (1941). *Quart. J. Med.*, **10**, 1.
MARSHALL, C. D. (1895). *Roy. Lond. ophthal. Hosp. Rep.*, **14**, 56.
WHEELER, J. M. (1916). *Trans. Amer. ophthal. Soc.*, **14**, 742.

Brit. J. Ophthal. (1953) **37**, 731.

OCULAR MANIFESTATIONS IN LÖFFLER'S SYNDROME*†

BY

C. M. J. VELZEBOER

From the Amsterdam University Eye Hospital, Netherlands

SINCE Löffler (1932) showed a radiograph of transient infiltration of the lungs associated with blood eosinophilia, many cases of Löffler's syndrome have been reported. The symptomatology is as follows:

The well-being of the patient is not disturbed, the blood count shows a slight leucocytosis, and there is always a more or less considerable increase in the number of eosinophils (10–60 per cent.). The shadows on the *x*-ray photograph of the lung vary considerably in size, but, and this is a most characteristic feature, they always disappear in a few hours or a few days.

Löffler could say little about the aetiology, but supposed that various aetiological agents were operative. An allergic response of the tissue seemed probable. He considered that one of the most important allergic noxae might be of tuberculous origin (Löffler, 1936).

After reviewing the papers that have appeared since 1932 it seems difficult to agree with Löffler and others (1952) that the clinical picture of the condition may now be considered to be clearly delineated (*fest umrissen*).

As an introduction to this difficult matter, a concise summary of our present knowledge is quoted from Reimann (1947):

Transitory lung infiltration with eosinophilia is believed to be the result of the reaction of sensitized lung tissue to an antigen. Persons suffering from asthma, allergic rhinitis, and urticaria occasionally develop the signs and symptoms of a mild inflammation of the lung. The syndrome has been observed in tuberculosis, ascariasis, trichinosis, amoebiasis, cutaneous helminthiasis, and other parasitic diseases.

The allergic character of the syndrome seemed especially evident in a description by Engel (1936) of a personal experience of the condition. His well-being was slightly disturbed. He had a mild cough, and there was some clear yellow sputum. This sputum did not contain any cells, so that, according to Engel, it had to be considered as a transudation sputum, but most investigators did find eosinophils in their cases. The shadow in Engel's *x*-ray picture disappeared in a few days. He was living in Shanghai and the disease was found to have an epidemic character in that city, and to occur every year about the months of May and June. He concluded that it was an allergic manifestation coinciding with the flowering-time of the bush Lingustrum.

*Received for publication April 15, 1953.

†Slides of this case were shown by Prof. Hagedoorn at the "Sheffield Lecture" (North of England Ophthalmological Society) on January 25, 1952.

Hansen-Pruss and Goodman (1944) and other workers described asthma as occurring in the same patients who showed Löffler's syndrome, and believed asthma to be an important factor in its aetiology. But Breton (1938) reported finding Löffler's pneumonia in 5–8 per cent. of his asthmatic patients. He remarked that since Löffler's pneumonia seemed to be an allergic condition and that asthma was a very common allergic disease, the combination of the two was only to be expected. In agreement with all former authors, Breton described the shadows on the *x*-ray picture of the lungs as transitory; however, he observed for the first time that in some cases tiny scars might remain visible in the *x*-ray. This was a very important fact, since up to that time the condition was considered to be completely reversible.

Löffler's pneumonia is frequently seen in patients with intestinal parasites. The pulmonary infiltrations in tropical eosinophilia are not as fugitive as in Löffler's cases. There is always asthma and sometimes splenomegaly. The causative agent is considered to be a mite (Crofton and others, 1952). Arsenicals have a striking therapeutic effect.

In moderate climates, *Ascaris* is frequently met with in patients with transient infiltrate of the lungs, as in 23 of the 100 cases described by Maier (1943).

> The eggs hatch in the duodenum or jejunum and the emergent larvae enter the intestinal wall and make their way to the lungs *via* the mesenteric lymphatics or venules, vena cava, right heart and pulmonary arteries. They break out of the pulmonary capillaries into the air sacs, migrate up the respiratory tree, crawl over the epiglottis, are swallowed and become adult worms in the lumen of the small intestine. (Faust, 1947).

Several authors believe that this migration of the *Ascaris* larvae in the respiratory organs can be an important factor causing the transitory infiltrations of the lung. This view is supported by Löffler (1952), who states that in his opinion this migration of *Ascaris* larvae is the only certain aetiological factor. According to Sprent (1949) a direct toxic influence of the Ascaris is very uncertain, whereas there is no doubt about the strong antigenic capacities of *Ascaris* body and fluid in causing a hypersensitive reaction.

Löffler and others (1952) describe transient infiltrations of the lung with blood eosinophilia in three patients after the intramuscular injection of oil (depocillin); 5 to 20 days after the injections cloudy shadows could be seen in the *x*-ray but they disappeared as soon as the injections with oil were discontinued. Besides the shadows on the *x*-ray a considerable blood eosinophilia developed within 10 days (rising to as high as 76 per cent.). The general health was undisturbed, though on some days there was slight fever. These authors emphasize that only one out of these three patients had an allergic condition; in the other two no sign or symptom of hypersensitivity could be detected. Consequently they consider the allergic character of the disease to be uncertain. They refer to Essellier and others (1952) who had found very small emboli in the lung 24 hrs after the subcutaneous injection of vegetable oil. In discussing these findings, they suggest that the transitory infiltrations

in these cases might be due to a tissue reaction on a micro-embolus. To support this view they argue that in resorption eosinophilia a leucocytosis is found—as in Löffler's pneumonia—whereas an allergic eosinophilia is said to be associated with leucopenia. Additional evidence for the correctness of this theory—according to Löffler and his co-authors—is seen in the absence of precipitins, without which there would be no sound basis for accepting allergy. However, precipitins are often absent in definitely allergic diseases. Moreover it is doubtful whether the precipitins may be identified with antibodies in allergic conditions. Even if one were inclined to follow Löffler's analysis of the three patients, it does not seem justifiable to extend these theories to the syndrome as a whole. More substantial criticism is required before we abandon allergy as an underlying cause. Probably these causes are manifold.

Another most potent way of elucidating a clinical problem is to study its pathology. Since Löffler's pneumonia is a harmless disease, characterized by the transiency and reversibility of its signs, it seemed unlikely that a *post-mortem* study would ever be possible. The *post-mortem* findings of Meyenburg (1942) are therefore most interesting. He held autopsies on four cases of healthy men who died in accidents. Bronchopneumonic foci, sometimes infarctoid in shape, were found in the lungs, and there was a serous exudation in the alveoli with many cells, mostly eosinophils (10–100 per cent), and some giant cells, probably derived from the alveolar epithelium. A pneumonic infiltration in the typical sense only affects the alveoli, not the interalveolar septa; it is a reversible process and consequently the clinical picture may be a transitory one. Hence these pathological findings fitted in very well with the clinical picture of Löffler's pneumonia. But two cases showed perivenous infiltration of leucocytes with thrombophlebitis, and in one case interstitial infiltration was also seen. Meyenburg thought it doubtful that such an infiltration clinically could have had a transient character; moreover, in one case a focal necrosis was seen and consequently these infiltrations could not be identified with the classical reversible pneumonic process.

It will be remembered, however, that Breton (1938) had already observed clinically that the infiltration might leave tiny scarlike shadows on the *x*-ray picture, and this makes us doubt whether, in all cases labeled " Löffler's pneumonia ", no traces ultimately remained. A further search in the literature with this point in mind gave interesting results.

Reeder and Goodrich (1952) described four patients with pulmonary infiltrations and eosinophilia ("P.I.E." syndrome). In all four the disease had a prolonged course. In two cases there was a quick recovery after cortisone and ACTH, and no traces were left. A third patient showed besides pulmonary infiltration and eosinophilia, albuminuria and cylinderuria. Biopsy of the gastrocnemus muscle did not reveal periarteritis nodosa. The *x*-ray picture was, when last seen, normal. The fourth patient, who had

fever and pain in several muscles, showed in an excised atrophic testicle the picture of periarteritis nodosa. He died from a cerebro-vascular accident and *post-mortem* examination revealed periarteritis nodosa in several organs, but not in the lung vessels.

Crofton and others are inclined to classify cases with eosinophilia and pulmonary infiltration in different groups:

(1) the very benign transient condition as described by Löffler;
(2) cases with a more prolonged course;
(3) prolonged cases with asthma;
(4) tropical eosinophilia (possibly also belonging to this syndrome)
(5) cases with periarteritis nodosa

In the first group the condition seems to be completely reversible, but in several cases with a prolonged course, permanent lesions, such as bronchiectasis, were found. In some patients with asthma and pulmonary eosinophilia inflammation and necrosis were found elsewhere in the body, but a definite diagnosis of periarteritis nodosa could not be made.

Harkavy (1941) described six patients with asthma, pulmonary infiltration, and considerable blood eosinophilia. Infarction in other parts of the body (liver, cutis, pleura etc.) and urticaria also occurred. The shadows on the *x*-ray picture of the lung were not fugitive. The lesions elsewhere were not quite typical, but strongly reminiscent of those in periarteritis nodosa.

Buckles and Lawless (1950) described a patient in whom pneumectomy was done on account of a shadow in the apex of the right lung, and a tumour was suspected. There was an eosinophilia of 43 per cent. Histological examination revealed fibrotic tissue, infiltration with eosinophils, granulomata, endothelial cell proliferation, giant cells, arteriolitis, and periarteritis.

Several cases of periarteritis nodosa with pulmonary infiltration have been described (Bergstrand, 1946; Lumb, 1950; Smith, 1948; Reeder and Goodrich, 1952; Elkeles and Clynn, 1944). The last authors refer to the experiments of Rich (1942), and Rich and Gregory (1942a,b), who demonstrated a picture identical with periarteritis nodosa by the repeated injection of serum in rabbits. They consider it to be an extreme degree of allergic reaction of the vessels.

In thirteen cases of severe asthma with eosinophilia Churg and Strauss (1951) found periarteritis nodosa in several organs. There were also extravascular changes in the collagenous tissue, and in the stroma of some organs: granulomata with central necrosis (of collagen fibres and eosinophil cells) surrounded by macrophages and giant cells. These " allergic granulomata ", as they called them, were chiefly found near the smaller veins, leaving scarlike tissue especially around the vessels. Five of these thirteen patients showed Löffler's pneumonia.

Ehrlich and Romanoff (1951) described a patient with repeated attacks of severe asthma, resulting in cyanosis and deep coma. The patient died within 10 days. *Post-mortem* investigation revealed two tumour-like masses in the lungs with central necrosis and a brownish shell of mostly eosinophil

leucocytes. There was also involvement of all the coats of the arteries. Identical findings were met in the appendix in another patient. According to these authors:

Löffler's disease is a form of systemic allergic disease of mild character and good prognosis, in which the chief manifestations are confined to the pulmonary system. More severe forms may develop, and the extrapulmonary lesions may overshadow the pulmonary changes.

Ruzic and others (1952) described such an eosinophilic infiltrate in the wall of the stomach. Identical lesions have been described in the pleura, peritoneum, epididymis, and muscles. Since a localization in the eye has not been described up to now and moreover the ophthalmoscope enables us to follow the course of the infiltration *in vivo* it seems to be worth while to report our case in some detail.

Case Report

A female aged 37 was referred to hospital on December 7, 1950. She complained of haziness and veil before the right eye since December 4. She remembered having had the same experience some time ago, but it had then disappeared within half an hour. The behaviour of the patient was very unusual. During the examination by the ophthalmologist, she had fainted with incontinence of urine. On her arrival at the University Eye Hospital she managed with considerable difficulty to say a few words only. A diagnosis of hysteria would have been made if the right fundus had not shown a dense whitish infiltrate of considerable size. The possibility of a similar infiltration in the brain was suspected. However, after being admitted to the hospital she behaved quite normally, though she was very nervous.

Examination:

Left Eye: Visual acuity 1/3; after correction sph. −1: 3/4. No abnormality.

Right Eye: emmetropic, visual acuity 1. Anterior segment: no abnormality. The vitreous showed some opacities. In the fundus, temporal and superior to the optic disc, a whitish infiltration was seen, involving the innermost layers of the retina, since the vessels were invisible for some distance in this area. The retina surrounding the infiltrate was grayish, oedematous. No haemorrhages could be traced and the vessels outside the lesion were completely normal. The aspect of the lesions is evident from Fig. 1 (overleaf).

General physical and neurological examination, no abnormality.

x ray of lungs perfectly normal on December 9, 2 days after admittance.

Blood count: erythrocyte sedimentation rate 5/15; leucocytes 11.800; diff.: basophils 0; eosinophils 46 (two being unsegmented immature forms); neutrophils: non segmented 0, segmented 16, lymphocytes 32, monocytes 6; erythrocytes 4.320.000; Hb 90 per cent. (corr. value);

Blood sugar normal values;

Cholesterol 182 mg. per cent;

Wasserman reaction negative.

Previous History.—As a child she suffered from rickets. From early youth she had always been a nervous person and easily fatigued. She had also suffered from bronchitis, but this disappeared in later years. Seventeen years ago she said she had been treated for duodenal ulcer. Furthermore, in a concentration camp in Germany during the war, she had had encephalitis of moderate severity and had been hospitalized for 3 months. Her subjective complaints at that time were diplopia and headache. Two years ago she had an endometritis. She is short of breath from time to time and wheezes, especially before she goes to bed. She is not hypersensitive to any sorts of food, plants, and dust,

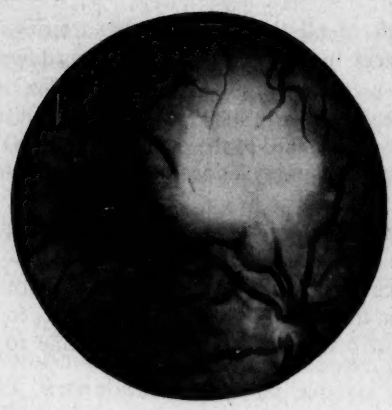

FIG. 1.—December 8, 1950.

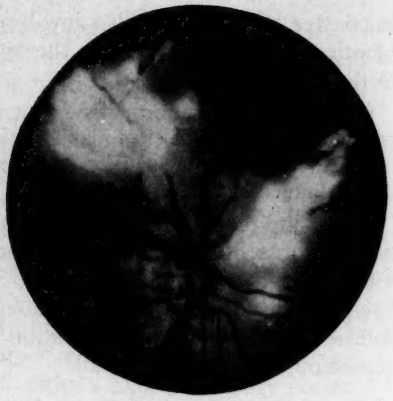

FIG. 2.—December 15, 1950.

with the exception of alcohol. If she washes with cold water the skin turns red with small itching vesicles, but as soon as she has dried herself and used some talcum powder, her skin recovers. 14 days before admission to hospital, she had taken tablets containing altogether 9 g. pyramidon for an attack of influenza.

Family History.—Her whole family had been completely annihilated in the war; her mother was said to have had the same constitution as our patient; she might sneeze continually the whole morning.

On account of this anamnesis special attention was given to a possible allergic condition, but all tests of the routine examination in the allergic department were negative. A skin test on pyramidon was also negative.

The marked eosinophilia was suggestive of the presence of intestinal parasites, but repeated examinations were negative.

Clinical Course of the Retinal Condition.—In the first days there was a marked improvement and the infiltration in the temporal upper quadrant diminished in size and intensity but on December 15 there was a sudden new infiltration in the nasal upper quadrant in the course of the nasal superior artery and vein (Fig. 2, December 15, 1950), whereas the original infiltrate was now resorbed to a considerable degree. On December 18 fresh infiltrations appeared in the retina, again mostly in the superficial layers (Fig. 3, December 24, 1950). Other infiltrates in the deeper layers now followed. The original more superficial process showed a white, dense cloudy aspect in which the vessels were discontinuous. The deeper infiltrations were more patchy and of a whitish-yellow colour.

Diagnosis.—The fugitive character of the retinal infiltrates together with the considerable blood eosinophilia called to mind the clinical picture of Löffler's transient pneumonia with marked blood eosinophilia. The *x*-ray picture of the lung was normal, but when it was repeated on December 20 there was a shadow in the superior and inferior lobe of the left lung. On December 22 the shadow was small and on December 28 it had completely vanished.

The condition of the lung was a most typical example of Löffler's pneumonic infiltrate, but the process in the fundus proved to be less transient in character. Nevertheless, the picture showed a vivid variability, which is evident from the further course and the fundus pictures.

Further Progress.—A whitish sheath around the nasal inferior vein was found on December 19 and this developed the character of a small retinal infiltrate. There were also some

FIG. 3.—December 24, 1950.

FIG. 4.—December 28, 1950.

tiny haemorrhages along the temporal inferior vein and artery, and oedema was marked in this region (Fig. 4, December 28, 1950).

On December 30 there was a definite regression of the infiltration in the superficial layers of the retina, whereas the process becomes more marked in the deeper layers (Figs 5 and 6, January 3 and 20, 1951).

FIG. 5.—January 3, 1951.

FIG. 6.—January 20, 1951.

Visual Fields.—A further unexpected finding was a visual field defect of the Jensen type corresponding with two lesions in the retina, one being the primary lesion. Still more unexpected was a visual field defect in the other eye, which in the whole course of the disease had shown only a tiny haemorrhage on February 8.

On January 13 vision in the right eye which had been 3/4 up to that time fell to less than 1/10. The region between the disc and the macula now showed a marked retinal oedema, but this was fugitive, and disappeared after some days; on January 20, vision in the right eye was 1/2, and on January 27, 3/4 again. During this time and in the following weeks

the fundus infiltration disappeared, with the exception of two lesions, the original one in the temporal upper quadrant and another in the nasal upper quadrant, both corresponding to visual field defects (Fig. 7).

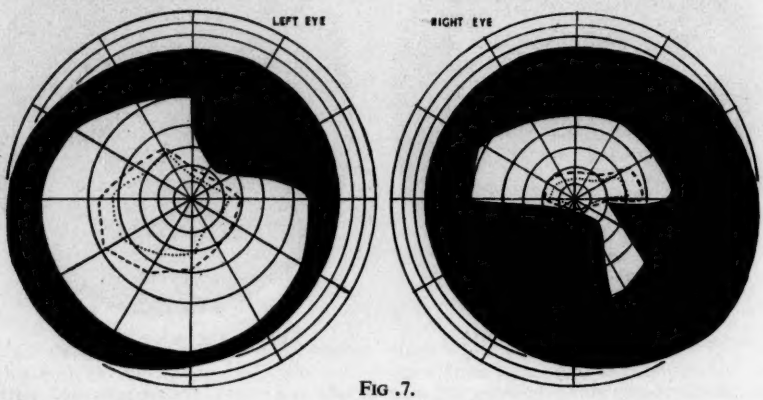

FIG .7.

Although the field defects were identical with those found in patients with Jensen's choroido-retinitis, the fundus picture and especially the cicatrices were unlike the findings in that disease (Fig. 8, February 13, 1951).

On February 27 the patient was discharged from the hospital. Vision in both eyes was 3/4, and the visual fields still showed the same defects. The left fundus was quite normal; and in the fundus of the right eye two cicatrices remained. They had a whitish appearance, like a fibrotic scar around the vessels, especially the vein which in that region was sheathed. No pigmentary disturbances were found.

Follow-up.—Leucocytosis (12000) and eosinophilia (40 per cent.) were still present. The patient was seen repeatedly in the Out-Patient Department, and no changes were seen in the appearance of the right eye (Fig. 9, June 13, 1951). In August, 1951, there were 9,200 leucocytes and 11 per cent. eosinophils. When she was last seen one year later, in August, 1952, the blood count was normal: 8,600 leucocytes and 4 per cent. eosinophils.

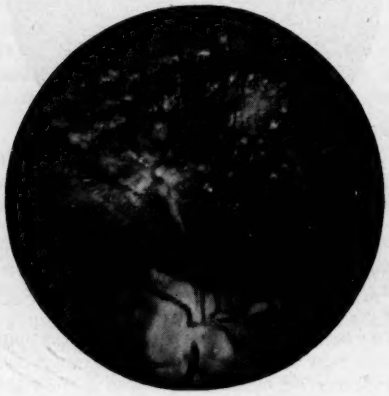

FIG. 8.—February 13, 1951.

FIG. 9.—June 13, 1951.

Comment

There seems to be no doubt that the process in the fundus and the infiltrates in the lung must have had a common origin. The infiltration in the lung was very fugitive and may have had a pneumonic character, corresponding with the pathological findings described by Meyenburg (1942). The pathological appearance of the right eye, though extremely variable in extent, did not disappear as completely. No permanent lesions in other places of the body could be traced though the prolonged course of the eosinophilia points to a persistent alteration in the bone marrow.

It is tempting to consider what might be the pathological basis of the appearance of the fundus. It can be supposed that the very dense infiltration mainly of eosinophilic cells into the retina, transudation (oedema), and focal necrosis, must be held responsible for the irreversible lesion of the nerve fibre layer, and caused the defects in the visual fields. The infiltration seemed to be related rather to the veins than to the arteries. This may remind us of the allergic granulomata, found by Churg and Strauss (1951) near the smaller veins, resulting in scars around them. It is difficult to state definitely whether or not the vascular walls were involved. Only some very small haemorrhages could be detected in the whole course of the disease.

Our patient clearly demonstrates that in Löffler's syndrome a benign reversible process may be found in conjunction with more severe conditions elsewhere in the body.

As to the aetiology and pathogenesis, most authors agree upon an allergic reaction of the tissue. In our patient an antigenic noxa could not be detected. A hyperergic reaction to pyramidon can be excluded, as in such cases a marked leucopenia is always found.

The visual field defects recall Jensen's chorioretinitis. But in our patient the inflammation and the scars were restricted to the retina and differed from the typical chorioretinal scars in Jensen's disease and the pigment-epithelium was not disturbed. Moreover, the visual field defect of the left eye, with a normal fundus picture, could only be explained by a local affection of the left optic nerve.

The blood eosinophilia persisted for more than a year after the healing of the process in the retina and lung; and cannot thus be due to a resorption eosinophilia, as suggested by Löffler, but must be identical with the blood eosinophilia in allergic conditions, which is supposed to be an allergic response of the bone marrow. Habelmann (1940) found typical alteration in the leucopoietic bone marrow in allergic diseases: *e.g.* immaturity and eosinophilia. This eosinophilia did not always give a blood eosinophilia. There was some parallelism in the severity of the clinical picture and the picture of the bone marrow.

Summary

A woman aged 37 was admitted to hospital with severe infiltration of the

retina of the right eye. The process had a variable character, and there was a considerable blood eosinophilia (49 per cent.). As the *x* ray of the lung showed a fugitive infiltration, a diagnosis was made of Löffler's syndrome with ocular complications. No intestinal parasites were found.

The shadow on the lung completely disappeared, two permanent lesions remained in the fundus, and were held responsible for two visual field defects of the Jensen type. Moreover a visual field defect of the left eye, where no infiltration was found, could be detected.

The possibility was shown that in conjunction with a reversible process as described by Löffler, more severe permanent lesions may result as found by Meyenburg in *post-mortem* examinations in cases of Löffler's pneumonia.

REFERENCES

BERGSTRAND, H. (1946). *J. Path. Bact.*, **58**, 399.
BRETON, A. (1938). *Paris méd.*, **1**, 538.
BUCKLES, M. G., and LAWLESS, E. C. (1950). *Dis. Chest*, **18**, 312. *Cited by* Crofton and others (1952).
CHURG, J., and STRAUSS, L. (1951). *Amer. J. Path.*, **27**, 277.
CROFTON, J. W., LIVINGSTONE, J. L., OSWALD, N. C., and ROBERTS, A. T. M. (1952). *Thorax*, **7**, 1.
EHRLICH, J. C., and ROMANOFF, A. (1951). *Arch. intern. Med.*, **87**, 259.
ELKELES, A., and GLYNN, L. E. (1944). *Brit. J. Radiol.*, **17**, 368.
ENGEL, D. (1936). *Beitr. Klin. Tuberk.*, **87**, 239.
ESSELLIER, A. F., MARTI, H. R., and WAGNER, K. *Cited by* Löffler and others (1952) as in the press.
FAUST, E. C. (1947). *In* Cecil, R. L. " A Text-book of Medicine ", 7th ed. Saunders, Philadelphia.
HABELMANN, G. (1940). *Klin. Wschr.*, **19**, 1211. *Cited by* Urbach and Gottlieb (1946).
HANSEN-PRUSS, O. C., and GOODMAN, E. G. (1944). *Ann. Allergy*, **2**, 85. *Cited by* Urbach and Gottlieb (1946).
HARKAVY, J. (1941). *Arch. intern. Med.*, **67**, 709.
LÖFFLER, W. (1932). *Beitr. Klin. Tuberk.*, **79**, 369.
——— (1936). *Schweiz. med. Wschr.*, **66**, 1069.
——— ESSELLIER, A. F., DE MEYER, G., and MORANDI, L. (1952). *Ibid.*, **82**, 777.
LUMB, G. (1950). *Brit. med. J.*, **2**, 645.
MAIER, C. (1943). *Helv. med. Acta*, **10**, 95.
MEYENBURG, H. VON. (1942). *Schweiz. med. Wschr.*, **72**, 809.
REEDER, W. H., and GOODRICH, B. E. (1952). *Ann. intern. Med.*, **36**, 1217.
REIMANN, H. A. (1947). *In* Cecil, R. L., " A Text-book of Medicine ", 7th ed. Saunders, Philadelphia.
RICH, A. R. (1942). *Bull. Johns Hopk. Hosp.*, **71**, 123 and 375.
——— and GREGORY, J. E. (1943a). *Ibid.*, **72**, 65.
——— ——— (1943b). *Ibid.*, **73**, 465.
RUZIC, J. P., DORSEY, J. M., and HUBER, H. L. (1952). *J. Amer. med. Ass.*, **149**, 534.
SMITH, J. F. (1948). *J. Path. Bact.*, **60**, 489.
SPRENT, J. F. A. (1949). *J. infect. Dis.*, **84**, 221.
URBACH, E., and GOTTLIEB, P. M. (1946). " Allergy ", 2nd ed. Grune and Stratton, New York.

Brit. J. Ophthal. (1953) 37, 741.

AMYL NITRITE TEST IN PRIMARY GLAUCOMA*

BY

G. CRISTINI and N. PAGLIARANI

Clinica Oculistica Universitaria di Bologna. Direttore: Prof. Q. Di Marzio

THOUGH ocular hypertension is one of the fundamental symptoms of glaucoma, we have as yet little clinical evidence for an evaluation of its pathological significance and real severity. The only elements at our disposal are those inferred by the study of the pressure curve both spontaneous and after miotic drugs. These studies show that at the onset of the disease the basic pressure may still be normal, in spite of a certain degree of instability; during the course of the disease the tension rises with diurnal phasic variations of wide range; in the late stages of the disease these diurnal variations become smaller and the basic pressure rises to a very high level.

Leydhecker (1952) recently employed the usual provocative tests (water-drinking, lability, mydriasis) to define the changes responsible for this symptom and evaluate its severity. His attempts led to uncertain conclusions, because our knowledge of the function primarily impaired, and of the exact mechanism of the tests employed is uncertain.

In fact, the possibility of solving this problem depends upon the exact knowledge of the pathogenesis of hypertension as well as of the mechanism of action of the tests employed.

With regard to the pathogenesis of the symptom, our views are confined to-day to two hypotheses which may be considered complementary. The first, elaborating the old conception of Priestley Smith (1879, 1891), maintains that hypertension is caused by an anatomical obstacle to the outflow of the aqueous. This obstacle is to be sought, according to Ascher (1949), in the aqueous veins, and, according to Goldmann (1948), in the trabeculae of the anterior chamber. An anatomical obliteration in the anterior aqueous drainage channels would, however, lead to a blocking of circulation, which makes it hard to explain the clinical behaviour of intra-ocular pressure. A mechanical obstacle present at a certain hour of the day cannot possibly be absent at another hour of the same day, when tension falls (Duke-Elder, 1952). Thomassen (1948) suggests a functional hindrance to the aqueous outflow caused by increased pressure in the episcleral venous vessels, into which the aqueous flows. A second hypothesis put forward by one of us (Cristini, 1951a) postulates the vascular nature of hypertension. It would result from a rise in the hydrostatic pressures in the uveal capillary-

*Received for publication July 6, 1953.

venous system in consequence of a progressive obliteration of the capillary network, by analogy with what is now generally accepted as the pathogenesis of the neural symptoms in glaucoma.

These two hypotheses do not exclude each other, but, as Urrets Zavalia (1952) asserts, they may be complementary: with the rise in capillary venous pressure the functional hindrance to the outflow of the aqueous would also occur simultaneously in the recipient episcleral venous vessels. In any case, the function primarily impaired would be the uveal vascular function.

In order to investigate the impairment of the functions assumed to be responsible for ocular hypertension, it appeared indispensable to employ a drug with a vasodilatory action on the small uveal vessels. We chose amyl nitrite because it is easy to use and rapid in action, and has a vasodilatory effect on the small vessels. These latter properties exclude any other mechanism which might otherwise influence the variations in pressure. The effects of this drug on intra-ocular pressure in glaucomatous patients had already been studied by Bailliart and Bollack (1921), who had observed, in three cases, a rise in ocular tension and a fall in brachial arterial pressure. Cristini (1947), in a larger number of glaucomatous patients, saw a fall in ocular tension which varied in each individual.

Assuming that hypertension in glaucoma is due to a pathological process of this nature, the effect of amyl nitrite on the small vessels may supply interesting information regarding the pathological conditions of the uveal circulation in glaucomatous patients, and the possibility of a widening of the capillary network in consequence of a dilatation of the lumina and the opening up of areas of vascular reserve.

Technique

The brachial pressure and ocular tension (Schiötz tonometer) were measured simultaneously; the patient was then made to inspire some drops of amyl nitrite. The brachial systolic pressure and ocular tension were repeatedly measured, first at short intervals of 10 to 15 sec., and then at intervals of about 30 sec. for a period of 4 to 5 min.

To obtain fuller details of the conditions of uveal circulation, the research was carried out in three conditions:

(1) in basic conditions, *i.e.*, without previous instillation of drugs, to find out to what degree the network of the small uveal vessels was able to widen in relation to the different stages of glaucoma;

(2) after the instillation of cholinergic drugs which produce a dilatation of the small vessels and the opening up of new vascular areas (Cristini, 1947, 1949, 1951a, b; Duke-Elder, 1952; Urrets Zavalia, 1952);

(3) after blocking the stellate ganglion by means of novocain to abolish the sympathetic control, which acts chiefly on the small uveal vessels (Greaves and Perkins, 1952), with the purpose of examining the neural control of the widening of the capillary network.

The research was carried out on fifty glaucomatous eyes whose diurnal phasic variations had been previously studied before and after the instillation of cholin-

ergic drugs (pilocarpine and eserine); the test was repeated several times in order to confirm the results and to find out if the diurnal phasic variations had any influence on them.

Results

The rapidity with which the changes in intra-ocular pressure appear after inspiration of amyl nitrite demonstrates the action of this drug on the small uveal vessels. The absence of relationship between the fall in brachial pressure and the fall in ocular tension, and the fact that the former very often followed the latter, permitted us to exclude a dependence of the uveal circulatory changes upon the general arterial pressure changes.

(1) *In Basic Conditions.*—The fall in intra-ocular pressure was larger in subjects who had already spontaneously shown extensive diurnal phasic variations and in those patients in whom the action of miotics had been more pronounced.

The fall was very small or absent in patients showing normal ocular tension, or during the absolute stage. In congestive glaucoma no fall in tension was observed; on the contrary, during the second phase of amyl nitrite inspiration a short rise in ocular tension above the initial values occurred (Fig. 1A).

(2) *After Instillation of Cholinergic Drugs.*—The fall in intra-ocular pressure was very small and was almost completely absent in those cases in which ocular tension had been normalized by the drug (Fig. 1B).

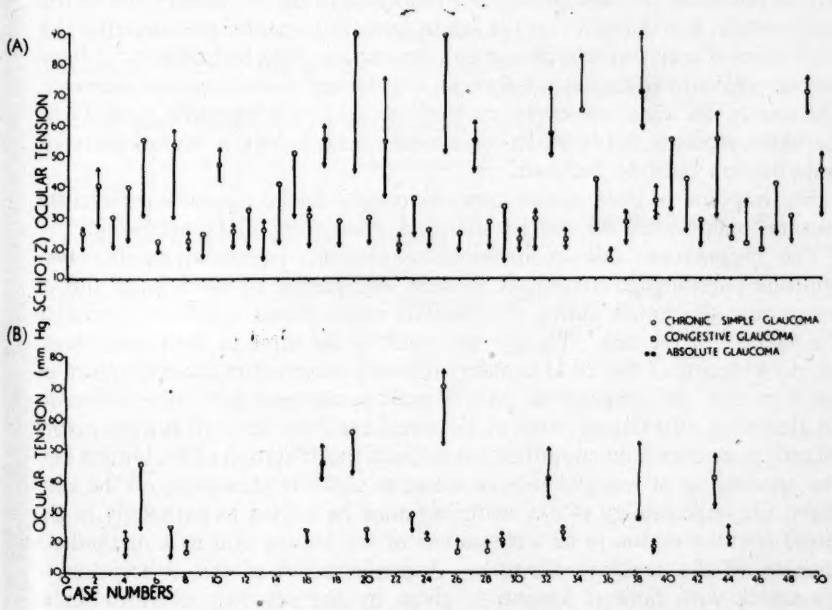

FIG. 1.—Amyl nitrite test in fifty patients with glaucoma.
(A) In basic conditions. (B) Under cholinergic drugs.

(3) *After Blocking of Stellate Ganglion.*—The variations in tension showed greater irregularity. They were mostly characterized by a fall reaching much lower values than the basal tension, and a short rise to a higher level (Fig. 2).

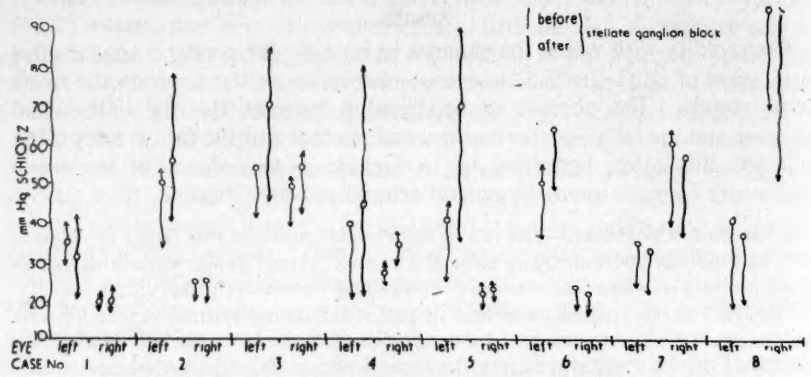

FIG. 2.—Amyl nitrite test in eight cases of primary glaucoma, before and after unilateral stellate ganglion block.

Discussion

As glaucomatous hypertension is determined by increased uveal capillary venous pressures, in consequence of a reduction of the circulatory bed of the small vessels, it is thought that the fall in basic intra-ocular pressure after the inspiration of amyl nitrite is caused by a diminution of the hydrostatic capillary venous pressures in the uvea following a widening of the capillary network. The rate of decrease, moreover, may be related to the widening capacity of the uveal capillary network; in cases where no fall occurs, impossibility of amplification must be deduced.

The response of intra-ocular pressure to amyl nitrite inspiration therefore acquires significance for the pathological evaluation of the symptom.

The insignificant fall in intra-ocular pressure registered in the two opposite pathological conditions, in cases with normal ocular tension and in hypertonic glaucomas during the absolute stage, would appear to prejudice the validity of the test. Though the result is the same in both conditions, *i.e.* no widening of the uveal capillary network occurs after the inspiration of amyl nitrite, the responsible pathological conditions are quite different. In glaucoma with normal tension, the uveal capillary network is presumably already at its maximum amplification through the dilatation of the lumina and the opening up of vascular reserve areas; in absolute glaucoma, on the contrary, the impossibility of any widening must be related to pathology of the uveal circulation due to an obliteration of the lumina and to a marked reduction of the capillary network. A confirmation of this conception in glaucoma with normal tension is given by the response of intra-ocular pressure to amyl nitrite after the instillation of cholinergic drugs. The

vasodilatation elicited by these drugs, causing both dilatation of the lumina and the opening up of new uveal vascular areas, brings about the same condition as is spontaneously present in glaucoma with normal tension. This is the reason why the fall in intra-ocular pressure during the amyl nitrite test performed under the action of cholinergic drugs is small or absent.

Further investigations seem to be necessary for the interpretation of the behaviour of the ocular tension in cases of congestive glaucoma. Besides the absence of a fall after the inspiration of amyl nitrite—which might be understood on the basis discussed before—the ocular tension rose to a level higher than the initial values during the second phase. As a hypothesis, a defect in neurogenic control might be suggested, since the behaviour of intra-ocular pressure resembles that registered after sympathetic block.

Summary

The study of the amyl nitrite test in primary glaucoma performed in basic conditions, under the action of cholinergic drugs, and after unilateral blocking of the stellate ganglion, led to results which accord in general with the theory of a vascular pathogenesis of ocular hypertension in this disease.

It follows that the response to the amyl nitrite test may provide useful evidence for the clinical evaluation of the severity of this fundamental symptom in primary glaucoma.

REFERENCES

ASCHER, K. W. (1949). *Arch. Ophthal., Chicago*, **42**, 66.
BAILLIART, P., and BOLLACK, J. (1921). *Bull. Soc. franç. Ophtal.*, **34**, 472.
CRISTINI, G. (1947). *Ann. Oculist., Paris*, **180**, 530.
——— (1949). *British Journal of Ophthalmology*, **33**, 228.
——— (1951a). " XVI Conc. Ophthal. Britannia Acta, 1950 ", vol. 2, p. 865. London.
——— (1951b). *British Journal of Ophthalmology*, **35**, 11.
DUKE-ELDER, S. (1952). *Amer. J. Ophthal.*, **35**, 1.
GOLDMANN, H. (1948). *Ophthalmologica, Basel*, **116**, 195.
GREAVES, D. P., and PERKINS, E. S. (1952). *British Journal of Ophthalmology*, **36**, 258.
LEYDHECKER, W. (1952). *Klin. Mbl. Augenheilk.*, **121**, 174.
SMITH, PRIESTLEY (1879, 1891). " Glaucoma ". Churchill, London.
THOMASSEN, T. L. (1948). *Trans. ophthal. Soc. U.K.*, **68**, 75.
URRETS ZAVALIA, A. H. (1952). *Ann. Oculist., Paris*, **185**, 701.

Brit. J. Ophthal. (1953) 37, 746.

SMALL VOLUNTARY MOVEMENTS OF THE EYE*

BY

B. L. GINSBORG

Physics Department, University of Reading

IT is well known that the transfer of the gaze from one point to another, where the points are separated by large angles, is not accomplished in a single smooth movement. An investigation by Lord and Wright (1949) of movements of angles of 5° and less has shown that the same is true of smaller angles. In the present paper a detailed investigation of the small eye movements which occur when the gaze is transferred from one fixation point to another is described.

The work arose out of and employed the same method as an investigation of the small involuntary movements which occur when the subject keeps his gaze as steady as possible (Ditchburn and Ginsborg, 1953). The experiments were carried out on two subjects (B.L.G. and D.M.M.) and were concerned with angular movements from 20-min. arc to 4°. Results are reported for the time sequence and angular pattern of the eye movements and for the reaction time of the eye.

Methods

The subjects were seated in a medical examination chair which provided support for the head and neck. The head was immobilized by biting on a rigidly mounted dental impression mouthpiece. The fixation targets were 450 cm. from the subjects' eyes and consisted of bright spots (about 0·02 c.p.) each subtending 2-min. arc at the eye.

The subjects wore contact lenses on which small plane mirrors had been worked (Ginsborg and Heavens, 1951). A fixed incident beam was directed on to each mirror and the reflected beam was directed on to continuously moving photographic paper. When the contact lens rotated through a small angle, the reflected beam was rotated through twice that angle. A continuous record of the rotations of the contact lenses could therefore be obtained. Provided there is no relative movement between the contact lens and the eye, this record then allows the movements of the eye to be deduced.

The optical system used in the first series of experiments (Method A) is shown diagrammatically in Fig. 1 (opposite).

I is the source of illumination (a high-pressure mercury arc) which is focused by the lens L_1 on to a pinhole aperture 0. The light is them made parallel by the lens L_2 and illuminates two slits, S_1 which is vertical and S_2 which is horizontal. The lens L_3 focuses the pinhole 0 on to the mirror on the contact lens, and also focuses the slits S_1 and S_2 on to the photographic paper P. The cylindrical lens L_4 and the horizontal slit S_3 serve to provide a high intensity image of the edges of the slits on the paper. V.A. is the direction of the visual axis.

Two separate traces are produced on the photographic paper in the following manner:

When the mirror rotates about a vertical axis, S'_2 (the image of S_2) is deflected to the left or to the right and thus causes a deflection of the trace. When the mirror rotates about the horizontal axis, S'_1 moves upwards or downwards along its own length causing no deflection of the trace.

*Received for publication October 23, 1952.

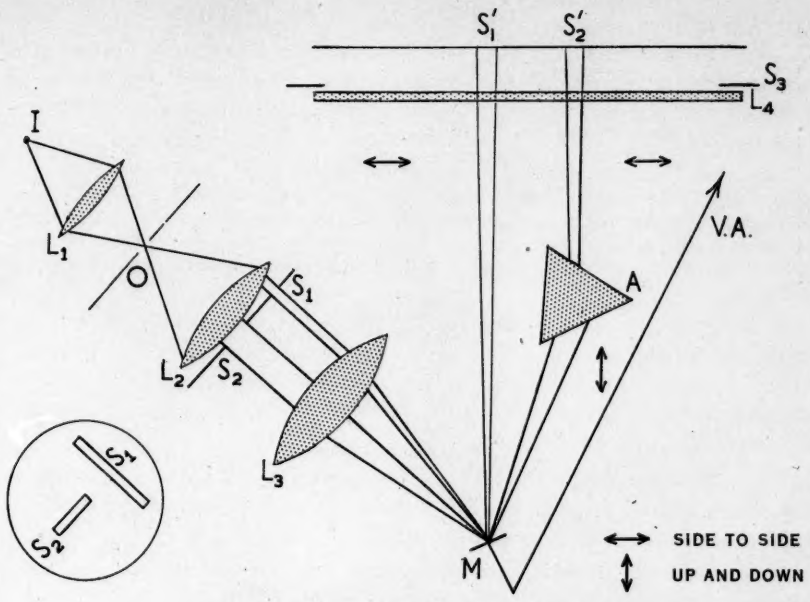

FIG. 1.—Optical system used in all experiments.

The vertical slit Sr therefore serves to record the component about the vertical axis of the rotation of the eye. The image of the horizontal slit S'_1 moves upwards and downwards when the mirror rotates about a horizontal axis and moves along its own length when the mirror rotates about a vertical axis. The upwards and downwards movements of the image, which are proportional to the rotation of the eye about a horizontal axis, are converted into a sideways deflection of the trace by interposing the right-angled prism A, with its base tilted 45° to the horizontal, in the beam.

The smallest rotation which could be detected was about 12-sec. arc. The duration of any movement could be measured to about 5 millisec.

In a second series of experiments (Method B) the optical system was modified. The slits were replaced by a pinhole aperture, the image of which was projected on to a stationary plate which replaced the continuously moving photographic paper. The image of the pinhole moved directly with the eye so that the trace obtained was a projection of the eye movements on a frontal plane. The method has the obvious advantage that the angular pattern of the eye movements may be deduced immediately from the trace, whereas Method A requires a graphical construction. Method B is not however suitable for binocular recording nor is it possible to deduce the duration of a movement from the records. Method A was therefore used for experiments in which time relations or binocular records were required and Method B, for investigations of the angular patterns of eye movements.

Results

I. Movement of the Contact Lens relative to the Eye.—The possibility of relative movement between the eye and contact lens when the subject voluntarily transferred his gaze from a point A to a second point B was first investigated. In the case of involuntary movements of the eye (*i.e.* those which occur whilst the subject attempts to keep his gaze fixed), there is con-

siderable indirect evidence (Ditchburn and Ginsborg, 1953) that the contact lens moves precisely with the eye. It is nevertheless clearly desirable to obtain direct evidence by comparing the rotation of the contact lens, as deduced from the records, with the known angular separation of the fixation targets A and B. The procedure adopted was as follows:

The subject fixated on a point A for 10 sec. and a continuous record was taken for this period using Method A. The camera was then stopped and restarted at a signal from the subject that he was fixating on point B. The angular separation of A and B varied between 20-min. arc and a 4° arc. In some experiments the subject removed his head from the dental impression mouthpiece and relaxed between recordings of fixation on A and B.

In all cases the mean separation of the traces agreed with the angular separation of the fixation points to $\pm$ 3-min. arc. During fixation the eye moves $\pm$ 10-min. arc around a central point. The above results thus provide confirmation that there is no relative movement between contact lens and eye, at least up to an angle of 4°.

IIA. Time Sequence of Small Eye Movements.—In order to investigate the time sequence of small eye movements, continuous records (Method A) were taken for periods of about 10 sec.:

The subject fixated on point A for 5 sec., rapidly transferred his gaze to point B, and fixated on the latter for a further 5 sec. A selector switch, controlled either by the subject or an assistant, extinguished point A and illuminated point B simultaneously. The angular separation of A and B was again varied between 20-min. arc and 4° arc.

The general behaviour of the eye for angles between 1°–4°, as deduced from records of the components of the movements, is shown in Fig. 2*a*, *b*, *c* (opposite). The movement starts as a sharp saccade carrying the eye through an angle which varies from half the angular separation of A and B to an angle slightly greater than the angular separation between A and B. So far as can be seen from these records, the saccade occurs in three stages:

There is a period of acceleration to a maximum speed, this speed is maintained for a further period and finally there is a period of deceleration.

The mean velocity of rotation during the saccade varies with the excursion involved, increasing with larger excursions (Fig. 3, opposite). A more detailed investigation could be made by means of a high-speed drum camera.

The direction of the movement is not confined to the direction of separation of A and B. In those cases where a marked undershoot has occurred (and on the rare occasions where there is an overshoot) the saccade is followed by a period during which the eye moves comparatively little. Such movement as does occur during this period ranges in speed between 5 min. arc per sec. and 2° per sec. and may be either towards or away from the final fixation target. The minimum period of this drifting movement is 0·15 sec., and the maximum 0·88 sec. The correlation between duration of drift and "error" from the final fixation point is not very high, but large errors are invariably associated with short periods (0·15 to 0·30 sec.). Where a marked undershoot

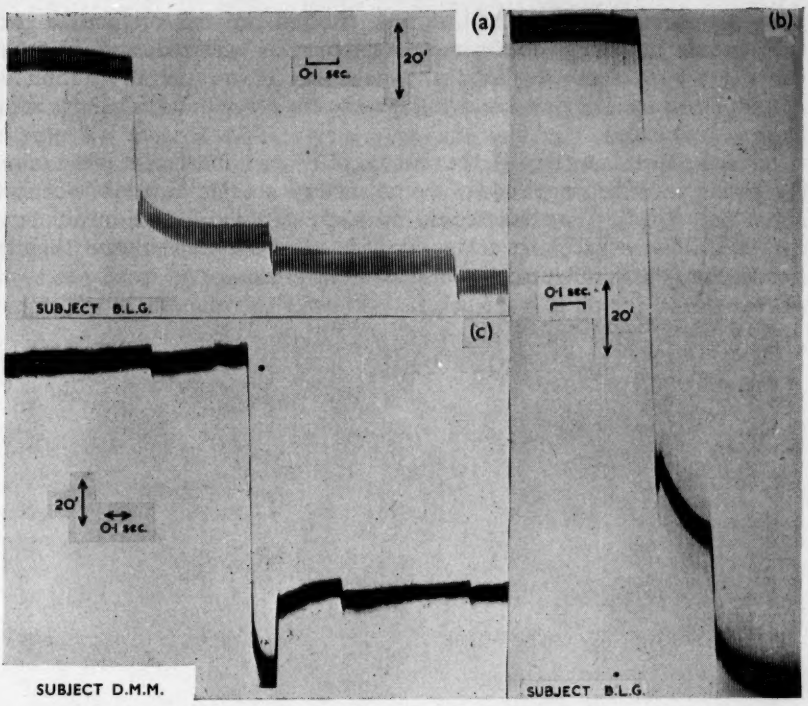

FIG. 2.—Component of rotation of the eye about a vertical axis when the gaze is transferred from one point to another. The points are on a horizontal line separated by the following angles: (*a*) 80 min. arc. (*b*) 4°. (*c*) 2°. Time increases towards the right.

or overshoot has occurred, the next stage of the movement is a further saccade which carries the eye to within about 10 min. arc of the correct direction of fixation. This is followed by a gradual drift towards the fixation point. Normal involuntary eye movements corresponding to fixation are superimposed on this drift which may last up to one second.

The frequency of involuntary flicking during this drift and a further 2 or 3 seconds is, how-

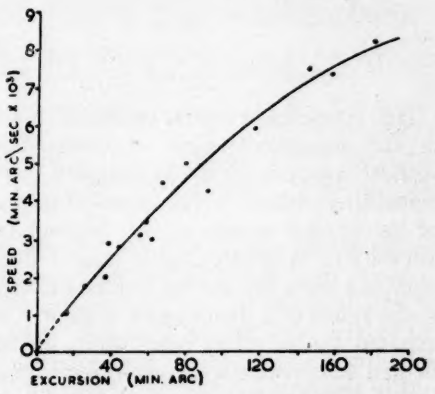

FIG. 3.—Relation between maximum speed occurring in saccade and magnitude of saccade.

ever, significantly higher than during fixation on the original target. Where no marked undershoot or overshoot has occurred, and, in most cases, for movements smaller than about 1°, the transfer of fixation is accomplished by a single saccade followed by the gradual drifting movement as described above.

In binocular vision (Fig. 4), the time taken by each movement is the same for both eyes. The magnitude of the movements are not, however, identical for subject B.L.G. For the saccade, as has been found for the involuntary flick with this subject, the temporal flick of one eye is always slightly greater than the simultaneous nasal flick of the other.

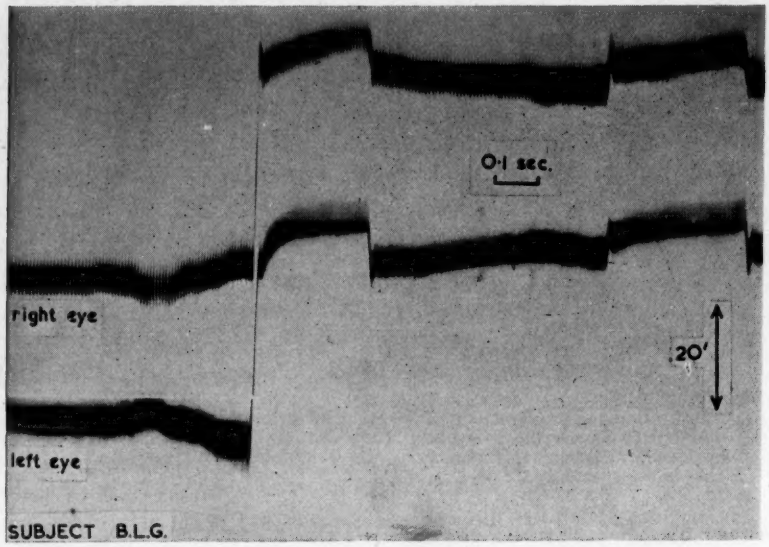

FIG. 4.—Gaze transferred through angle of 40 min. arc. Components of rotation of both eyes about a vertical axis. Time increases towards the right.

IIB. Angular Pattern of Small Movements.—The angular pattern B of the movements may be deduced by combining the horizontal and vertical components of the rotation graphically. Method B, however, provides direct traces of the movements projected in a plane, and some idea of the relative speeds of the different types of movement is given by the intensity of the photographic trace. Fig. 5(*a*) illustrates the type of record obtained when the subject fixates successively on three points (A, B, and C) at the apices of a right-angled triangle. In this case the subject momentarily exposed the recording beam, using the hand as a shutter, when he believed he had achieved satisfactory fixation on each point in turn.

Figs 5 (*b*) and 5 (*c*) illustrate records taken when the subject fixated on each of three points at the apices of a triangle, transferring his gaze as rapidly

as possible between each fixation, but maintaining his gaze on each point until he was satisfied he was fixating correctly. It can be seen that the first saccade carries the eye in a straight path, which, however, is not in a line joining the fixation points. The drifting movement which occurs at the end of the first saccade appears as a more intense trace. In upward oblique movements this drift occurs in a characteristically curved path. Figs 5 (*d*) and 5 (*e*) were obtained when the gaze was transferred between two points on a horizontal line, and two points on a vertical line. It is clear that in this type of experiment, where the eye moves from point to point, the subject does not fixate as accurately as is possible during prolonged fixation on a single target, although he is satisfied subjectively that he has transferred his gaze to the new fixation point. This observation is confirmed by the continuous component records described above.

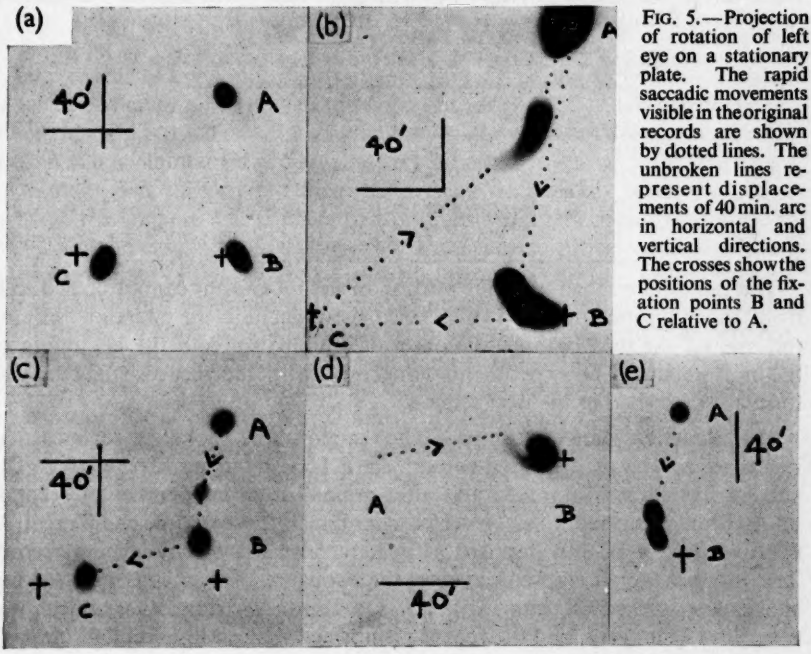

FIG. 5.—Projection of rotation of left eye on a stationary plate. The rapid saccadic movements visible in the original records are shown by dotted lines. The unbroken lines represent displacements of 40 min. arc in horizontal and vertical directions. The crosses show the positions of the fixation points B and C relative to A.

III. "Accuracy" of Direction of Fixation after Larger Eye Movements.—A comparison of the experiments described in Section I with those in Sections IIA and IIB shows that if the subject is allowed an indefinite time to fix his gaze on a target, the image falls on a small and definite area of the fovea. Nevertheless, subjectively satisfactory fixation is obtained, although the image falls outside this region. In order to extend observations of this phenomenon, the following series of experiments were carried out using Method A.

The subject fixated on a point separated from the final fixation point by an angle of 20°–30°. The initial fixation point was then extinguished and the subject kept his gaze as steady as possible, in total darkness. After a short period, the final fixation point was illuminated together with a time mark on the record. In order to maintain the sensitivity of recording only the terminal portion of the movement was recorded.

The angular separation between the visual axis, when the subject first considered fixation satisfactory and final direction of fixation was about 1°. After this time the subject was, on most occasions, not conscious that further eye movement was occurring. Nevertheless a gradual drift did take place, until finally the mean position of the visual axis was within ± 3 min. arc of the calculated direction for fixation on the final target. The times taken for the movements in one series of experiments are given in the Table.

TABLE

TIME BETWEEN ILLUMINATION OF TARGET AND VISUAL AXIS TO REACH SEPARATION

(*i*) FROM TARGET OF 1° ARC

(*ii*) FROM TARGET OF ± 3 MIN. ARC. (*Total movement* 20°)

Target	1° arc	± 3 min. arc.
Time (sec.)	0·28	1·91
	0·16	1·65
	0·29	2·23
	0·32	1·68
	0·43	3·12

The times taken for the major portion of the movement cannot be deduced from those quoted in the Table, since these include the reaction time of the eye, *i.e.* the time between the onset of illumination and the beginning of the movement. The experiments concerned with the measurement of this time are described in the next section.

IV. Reaction Time of the Eye.—The reaction time of the eye for measurements up to 4° was measured for subject B.L.G. by using Method A. The subject fixated on Target A, and after a small random number of seconds an assistant operated a switch which simultaneously extinguished Target A, exposed Target B, and imposed a time trace on the eye-movement record. The interval which elapsed between the exposure of Target B and the eye movement towards it was variable. On some occasions the subject was conscious of a delay, and the records confirmed that an interval considerably larger than the minimum reaction time had elapsed. This minimum time was 0·14 sec., a period almost identical with the minimum time between two saccades when a voluntary transfer of the gaze occurs in more than one stage. In some of the records a small non-saccadic movement of the eye was observed about 60 msec. after the exposure of the second target. This movement was less marked or absent when the time marker was not used. Both the selector switch and the time marker were not completely silent, the time marker being noisier than the selector switch alone. It therefore seems possible that the non-saccadic movement is a response to the auditory signal involved in the change of target.

Discussion

The recording of small eye movements by sensitive methods has been directed almost entirely to the study of their effects on visual perception. The present paper for example reports part of a larger investigation with a twofold aim:

(*a*) to examine the involuntary movements of the eye which occur when a subject attempts to keep his gaze fixed.

(*b*) to study the effect of eliminating movements of the visual image relative to the retina.

The method of investigation involved the use of a contact lens, and clearly the validity of the results which were obtained depends in the first place on the precision with which the contact lens moved together with the subject's eye. The results reported here offer no evidence to suggest that the contact lens moves independently of the eye. In fact, the experiments reported in Section I constitute positive evidence that the lens moves with the eye with a high degree of precision.

The records of involuntary movements during fixation show that the visual image can be maintained on a fixed region of the fovea about 100 μ in diameter. When the gaze is transferred to a second point, the new visual image eventually falls on and is maintained on this same region of the fovea. It might therefore be thought that subjectively adequate fixation occurs only when the image falls on this region. The experiments described in Section II show that this is not the case, which suggests that two separate processes are involved in the movement of the visual axis towards a fixation point. The first process is concerned with establishing the visual image within the central 1° region of the fovea. This is achieved by one or more saccades, the interval between saccades never being less than the minimum reaction time of the eye. The second of two saccades is therefore comparable to the reflex response to the exposure of a new visual stimulus. Shortly after the end of the first process, the subject has a sense of adequate fixation. Moreover, voluntary movements between two fixation points may be carried out at a frequency of about 2 per sec. The maximum time for fixation on each of these points during such a process must be less than 0·5 sec. The results given in Section III suggest that this period would not allow " accurate " fixation. Nevertheless with prolonged periods, the eye employs greater " accuracy of fixation ", and a second process establishes the visual image on the central 20 min. arc of the fovea.

The double process in establishing the visual image on the central region of the fovea after a transfer of the gaze might be explained on the basis of the structure of the retina. The information transmitted to the brain, which determines the size of the initial saccade, must be based on the distance between the central region and the point on the retina on which the eccentric image falls. But it is well known that as one proceeds outwards from the fovea along the retina the number of receptors associated with a single ganglion cell, and hence with a single nerve fibre, increases considerably. No definite

information is available on the variation with eccentricity of the size of the independent receptor fields. Clemmesen (1945) suggests that the mean diameter of these fields increases up to an eccentricity of 3° from the visual axis, but that outside this boundary the receptors are linked so diffusely that it is not possible to speak of separate functional units. Nevertheless, if the image of a target point falls on an eccentric part of the retina it is likely that a particular nerve fibre exhibits a maximum of activity. As the eccentricity increases it is probable that the region on which the image can fall and still produce maximum activity in the same nerve fibre also increases. The information transmitted to the brain with respect to the magnitude and direction of the movement necessary to bring the image on to the central region of the fovea cannot then be at all precise. This hypothesis explains qualitatively the nature of the movements found in the present investigation, although it does not explain the serious undershoots which have been obtained in some cases (Section IIA). More extensive data would be required to obtain a quantitative test. If the hypothesis is correct there should be a definite relation between the eccentricity of the fixation target exposed and the fixation " error " after completion of the saccadic movements. It is also possible that such an approach would provide information about the size of the receptor fields. During the second process by which the image is brought on to the central region, the involuntary flicks, which are a significant feature of eye movements which occur when the subject fixates (see *e.g.* Ditchburn and Ginsborg 1953), are of greater frequency, than during prolonged fixation. This phenomenon has been found by Barlow (1952), who suggests that, since the exposure of a new fixation target presents the subject with a stimulus of greater interest than is involved in prolonged fixation, the increased frequency of involuntary flicks enhances the performance of the retina. In fixation, during the periods between the flicks, the image is almost stationary relative to the retina. During these periods, therefore, it is possible that the receptors become fatigued. The consequent decrease in impulses passing down the optic nerve might act as a stimulus for a rotation of the eye to a new position and so cause a flick. Where the interest of the subject is low, as towards the end of prolonged fixation, other processes may be responsible for inhibiting the movements. In any case, it is now certain that movements of the visual image relative to the retina do play some part in visual perception since the contrast discrimination of the eye is considerably reduced when such movements are eliminated (Ditchburn and Ginsborg, 1952).

I wish to thank Dr. D. M. Maurice for his cooperation in acting as a subject, Mr. W. Martin for valuable technical assistance, and Professor R. W. Ditchburn for his constant guidance and advice. During the course of this work I was in receipt of a maintenance grant from the Department of Scientific and Industrial Research.

REFERENCES

BARLOW, H. B. (1952). *J. Physiol., Lond.*, **116**, 290.
CLEMMESEN, V. (1944). *Acta physiol. Scand.*, **9**, suppl. 27.
DITCHBURN, R. W. and GINSBORG, B. L. (1952). *Nature, Lond.*, **170**, 36.
———, ——— (1953). *J. Physiol., Lond.*, **119**, 1.
GINSBORG, B. L., and HEAVENS, O. S. (1951). *Rev. sci. Instrum.*, **22**, 114.
LORD, M. P., and WRIGHT, W. D. (1949). *Nature, Lond.*, **163**, 803.

Brit. J. Ophthal. (1953) **37**, 755.

CASE NOTES

SYMPATHETIC OPHTHALMIA FOLLOWING AN OPERATION FOR RETINAL DETACHMENT*

BY

WALTER KORNBLUETH AND RICHARD STEIN

Ophthalmological Department, Rothschild Hadassah University Hospital, Jerusalem, and Tel Hashomer General Hospital, Israel

THIS report seems justified since no mention is made in the textbooks of ophthalmology and ophthalmic pathology of sympathetic ophthalmia following an operation for retinal detachment. Friedenwald and others (1952) state:

> Sympathetic ophthalmia has not as yet been reported following operations for detachment of the retina.

Duke-Elder (1940) does not include the operation for retinal detachment in the long list of those sometimes followed by sympathetic ophthalmia.

Case Report

A boy, aged 8½ years, was admitted to the Hadassah University Hospital with detachment of the retina in the right eye.

The family history revealed that the patient's father, his paternal grandmother, and his grandfather had had high myopia. Three of his grandmother's brothers had suffered from retinal detachment. At the age of 3½, tonsillectomy had been performed because of recurring angina, and he had had measles at the age of 6.

November 28, 1945, when 3½ years old, he was examined by Professor Feigenbaum who found excessive myopia (over 17 dioptres) and prescribed −15 D. for each eye.

September, 1950, he was seen again and complained of deterioration of vision in the right eye. Externally, the eyes did not show anything abnormal. Visual acuity was perception of light in the right eye, which had in the meantime received for correction −29 D. sph., and in the left eye it was 5/12 partly with correction −24 D. sph. comb. −1 cyl. Ophthalmoscopy of the right eye revealed an almost total detachment of the retina with large tears near the ora serrata at the lower temporal quadrant; the left eye showed extensive vitreous opacities and fundus changes typical of excessive myopia.

September 18, 1950, the right eye was operated on for retinal detachment. The lower bulbar conjunctiva was freed from 3 o'clock–10 o'clock and surface cautery applied to the sclera in this area at a distance of 6–13 mm. from the limbus. From 6.30–8.30 o'clock, at a distance of 8–10 mm. from the limbus, two rows of penetrating punctures were carried out with 1½-mm. Safar needles. A large quantity of subretinal fluid was evacuated. At the end of the operation, the retina was fairly well re-attached.

After the operation, the patient was very unruly and could not be kept quietly in bed.

September 24, 1950, vision in the operated right eye was counting fingers at 3/4 m. The visual field was constricted from above and on ophthalmoscopy the lower half of the retina appeared to be detached.

October 11, 1950, the patient left the hospital, and the detachment of the retina became complete. Visual acuity amounted to recognition of hand movements in front of the eye.

* Received for publication June 11, 1953.

December 25, 1950, externally, the right eye was slightly injected, the cornea clear, there was a hyphaema of 3 mm. and the iris was slightly discoloured. The lens was transparent and the vitreous filled with blood. The left eye showed no changes other than those described above.

March, 1951, the hyphaema in the right eye had disappeared but seclusion of the pupil had developed. The eyeball was very soft and had begun to shrink. Enucleation was advised but was refused by the parents.

June 17, 1951, the boy complained of severe pains in the right eye, and ran a high temperature. External examination of the right eye showed oedema of the lids, chemosis, slight haziness of the cornea, some fine keratic precipitates, and hyperaemia of the iris. The ocular tension was 56 mm. Hg Schiötz. During the next few days, the inflammatory symptoms increased, and exophthalmos, due to orbital cellulitis, developed. A diagnosis of endophthalmitis was made. On treatment with streptomycin and penicillin, applied generally as well as locally, the acute inflammatory symptoms subsided after a fortnight.

July 7, 1951, fine keratic precipitates were noticed for the first time in the left eye. The right eyeball was enucleated immediately. In spite of local and general treatment with cortisone (3 g.), the keratic precipitates in the left eye increased in size and number, nodules appeared in the iris, and posterior synechiae developed.

August 21, 1951, the retina became detached. During the following weeks the cornea was invaded by deep vessels, and seclusion and occlusion of the pupil appeared, accompanied later by a complicated cataract. Vision deteriorated to light perception with faulty projection, and eventually phthisis bulbi developed.

Pathological Examination

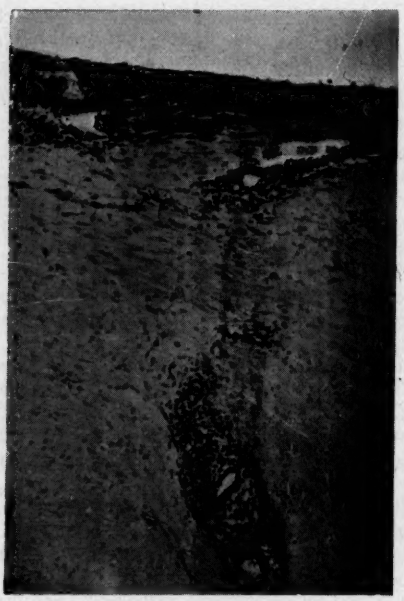

FIG. 1.—Diffuse infiltration of choroid with inflammatory cells, spreading along ciliary vessels. Haemotoxylin and eosin. ×85.

The dimensions of the enucleated right eyeball are 25 × 20 mm. The cornea, which is of normal thickness, shows some round cell infiltration near the limbus and invasion of blood vessels into the superficial and deeper layers. Precipitates, consisting mostly of lymphocytes with some pigment around them, are to be seen scattered on the corneal endothelium. The anterior chamber is filled with serum and some old blood. The iris shows anterior peripheral synechiae on both sides, and is oedematous, with dilation of the blood vessels and infiltration by lymphocytes and plasma cells. There are posterior synechiae and an inflammatory membrane is stretched over the anterior surface of the lens, which shows posterior cortical cataract. The ciliary body is heavily infiltrated with round cells and presents severe destruction of the pigment epithelium. There is a cyclitic membrane which is also infiltrated with round cells. The choroid shows heavy accumulation of round cells and some eosinophils which

FIG. 2.—Epithelioid cell nest in choroid surrounded by lymphocytic infiltration Haematoxylin and eosin. × 100.

FIG. 3.—Epithelioid cells containing fine melanin granules. Enlargement of frame marked in Fig. 2. Haematoxylin and eosin. × 240.

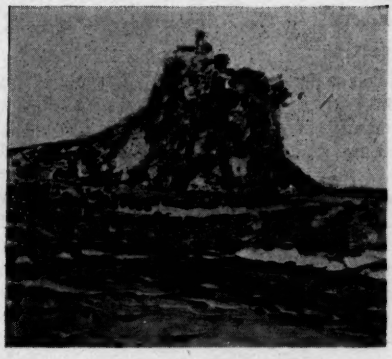

FIG. 4.—Dalen—Fuchs nodule. Haematoxylin and eosin. × 260.

also spread along the ciliary vessels and nerves (Fig. 1). In a few areas, nests of epithelioid cells containing phagocytosed uveal pigment granules are to be seen (Figs 2 and 3). Near the ora serrata, the pigment epithelium shows some small nodules which consist of pigment epithelium cells and epithelioid cells containing phagocytized pigment granules—Dalen-Fuchs nodules (Fig. 4). The retina is completely detached and atrophic. There is a massive intraocular haemorrhage. Diagnosis: sympathetic ophthalmia.*

Summary

A case of sympathetic ophthalmia following an operation for retinal detachment in an 8½-year-old boy is described. The sympathogenic eye was enucleated and in spite of energetic treatment with cortisone the sympathizing eye became phthisic.

REFERENCES

DUKE-ELDER, S. (1940) "Text-book of Ophthalmology", vol. 3, p. 2328. Kimpton, London.

FRIEDENWALD, J. S., WILDER, H. C., MAUMENEE, A. E., SANDERS, T. E., KEYES, J. E. L., HOGAN, M. J., OWENS, E. U., AND OWENS, W. C. (1952). "Ophthalmic Pathology. An Atlas and Textbook", p. 127. Saunders, Philadelphia.

*Dr. J. S. Friedenwald, to whom a slide was sent for consultation, agreed with the diagnosis.

Brit. J. Ophthal. (1953) 37, 758.

UNUSUAL CASE OF DOUBLE PRIMARY ORBITAL TUMOUR*

BY

IDA MANN, P. C. YATES, AND J. P. AINSLIE

Perth, Western Australia

THIS case is reported as being of interest from three points of view:

(1) Multiple primary malignant tumours are themselves rare in children.

(2) Two primary tumours of different pathological nature occurring in the same orbit at different times are very rare.

(3) New primary tumours occurring in areas treated by radiotherapy for a different type of tumour are rare.

The case concerns a schoolgirl who died at the age of 10 years from a meningioma arising in the roof of the orbit 6 years after surgical removal of a tumour of the optic nerve, gliomatous (astrocytoma) in nature. The orbit was treated with deep *x*-ray therapy after removal of the first tumour.

Case Report

History.—A little girl, born in 1942, was noticed at the age of 3 to screw up her left eye when looking at anything. She was taken to the Princess Margaret Hospital for Children and approximately a year later a tumour of the left optic nerve was removed through a Krönlein approach, the eyeball being left *in situ* and the tumour being apparently excised completely. Although the tumour was thought to have been completely removed and was reported by the pathologist as an astrocytoma, deep *x*-ray therapy was given to prevent possible recurrence. Deep therapy was begun in April, 1946, over a 7 × 7-cm. field including the whole orbit and optic foramen. In 2 weeks a dose of 3,300 r spread over ten applications had been given, with an estimated tissue dose of 2,500 r at the optic foramen. During May, June, August, September, October, and December, 1946, and January, February, and April, 1947, single monthly doses totalling 6,500 r (tissue dose 5,500 r) were given. A large *x*-ray burn, involving the cornea and conjunctiva and producing telangiectases of the lids, resulted. She was treated for the corneal ulcer which healed with obliteration of the fornices, adhesion of the lids to the globe and keratinization of the corneal epithelium. Eyebrow and eyelashes were permanently destroyed.

Recent Developments.—She was seen for the first time by one of us (P.C.Y.) in 1950, and at intervals until June, 1951. She remained well until this time when her mother noticed a swelling above the left supra-orbital margin. She was readmitted to the Princess Margaret Hospital and a portion of the swelling was removed for biopsy. The section showed a meningioma, and she was transferred to the Neuro-Surgical Unit of the Royal Perth Hospital. When presented to this Unit the child was suffering from a meningioma arising from the dura over the left frontal lobe. The tumour had invaded and destroyed a considerable portion of the adjacent frontal bone and presented as a soft swelling immediately beneath the skin above the left supra-orbital ridge. Tomographic studies demonstrated a large, roughly circular hiatus in the supra-orbital margin, and the anterior part of the frontal bone.

*Received for publication July 2, 1953.

Operations (J. P. A.).—A large meningioma (1½ inches in diameter) was found arising from the dura mater immediately above the left supra-orbital ridge. The dura, the tumour, and a portion of the frontal bone were excised in one piece, and the tumour appeared to have been completely removed together with a surrounding area of uninvolved tissue. Removal of the tumour presented no difficulty and it was widely removed together with at least ½ an inch of apparently uninvolved dura mater and a similar margin of uninvolved bone (Fig. 1). The extent of removal was not limited by involvement of any important structure and recurrence of the tumour was not expected. The operation left a defect of bone (a considerable portion of the left frontal bone, the supra-orbital ridge, and the anterior half of the orbital plate), and of dura which was repaired with fascia lata. An impression (in dental Stent) was taken and the skin flap closed. The wound healed. Fig. 2 shows the appearance of the child at that time. The flattening of the orbital margin and the old *x*-ray burn of the lids and eyeball can be seen.

A plastic operation (I.M.) was performed in February, 1952, with the object of freeing the lids from the scarred globe so that a prosthesis could be worn, but the skin of the upper lid was found to be firmly adherent to the dura and only partial mobility was attained.

A further operation (J.P.A. and I.M.) to free the dura and to insert a contact shell covered with a split thickness skin graft was performed but the outer canthus broke down later and the shell extruded.

FIG. 1.—Tumour removed in June, 1951. (Scale in inches).

FIG. 2.—Appearance of patient in July, 1951.

Later Developments.—At this time (March, 1952) a smooth painless swelling half an inch wide by three quarters of an inch long appeared in the left lower lid. The appearance of a tumour in the tissues of the lower eyelid at a stage when other evidence of recurrence was absent was totally unexpected. A further tumour also appeared above the left eye and complete exenteration of the left orbit was performed on March 27, 1952. It was

obvious that the meningioma had recurred with extensive involvement of ethmoidal cells and that it could not be completely removed. The wound healed and the child remained well for 3 months.

By July, 1952, the tumour had again recurred and was now the size of a tennis ball. The child had vomited once or twice and there was early papilloedema in the remaining eye. The portion of the tumour mass occupying the left orbit was very vascular and the patient was readmitted to hospital on account of hæmorrhage from it. A month later, during which there had been no bleeding and no deterioration of general health, the tumour had increased in size and had begun to overhang the right orbit and obstruct the visual field mechanically. It had also extended through the left ethmoid and protruded from about half an inch from the left nostril (Fig. 3). This protrusion was curetted away for the comfort of the patient but her condition then deteriorated rapidly. She became comatose and died on September 29, 1952, 15 months after the appearance of the second tumour.

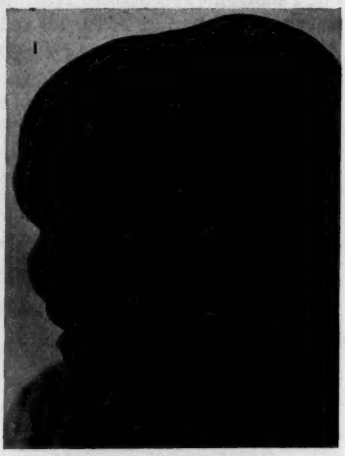

FIG. 3.—Appearance shortly before death of patient in September, 1952.

Pathologist's Report

The mass removed from the left orbit and the mass on the left cheek is described as follows: "The supra- and infra-ocular tumours appear to be of the same type. Both show many mitotic figures and nuclear anaplasia. The infra-ocular tumour is the more malignant, yet shows a more typical meningiomatous structure than the upper tumour. Both are malignant meningiomata. The section of the eyeball itself shows absence of retinal structure."

Discussion

The co-incidence of the occurrence of two tumours of dissimilar histological type at an interval of 6 years in a child is sufficiently rare to merit further consideration. The first tumour, a glioma (astrocytoma) of the optic nerve, was itself uncommon. Hudson (1912) found reports of less than 350 cases of optic nerve tumours of all kinds in all the medical literature; of these 118 were gliomata. Between 1912 and 1930, 61 further cases of optic nerve tumour were reported, 52 of them gliomata (Mathewson, 1930). Of the optic nerve tumours, therefore, glioma is the most common; 75 per cent. occur within the first 10 years of life and 88 per cent. before the age of 20. They are more common in females than males. They are slow growing and do not metastasize. If the tumour is completely removed the prognosis is good. Death, when it occurs, is from intra-cranial extension and may be delayed for years (*e.g.*, 26 years in a case reported by Pagenstecher, 1902). *X* rays are considered by Duke-Elder (1940) to be of little value.

Meningioma in children is rare. It usually occurs between the ages of 30 and 50 and is equally common in males and females. The tumours tend to be slow growing, encapsulated, and non-metastasizing. Very occas-

ionally, sarcomatous changes are present in them and they recur after operation, but usually they can be removed intact with a good prognosis. Recurrence after apparent complete removal, as in the present case, is rare, On the other hand, Myerson (1942) has described the association of gliomata of the chiasma with neurofibromatosis, but the present patient showed no evidence of Von Recklinghausen's disease.

The occurrence of more than one primary tumour in the same individual is not as rare as was at one time thought. It occurs in approximately 1 per cent. of all cancer cases, according to the British Empire Cancer Campaign Survey of Cancer in London (Harnett, 1952). This survey deals with 15,201 cases; the incidence of multiple primaries in the series is shewn in the Table.

TABLE

INCIDENCE OF MULTIPLE PRIMARY TUMOURS IN 15,201 CASES

Primary Tumours		Previous		Simultaneous		Subsequent	
		Another type	Same type	Another type	Same type	Another type	Same type
All Cases	No.	86	61	65	86	99	21
	%	1		1·1		0·8	
Total (excluding tumours of skin, large intestine, and mouth)	No.	76	17	51	20	92	5
	%	0·6		0·5		0·7	

If double primaries of the skin, large intestine, and mouth are deducted, the percentages are much smaller.

No case of tumour of the optic nerve was recorded in this double series, nor was any case at all found in the 15,201 records.

In another series of multiple primary malignant tumours collected by Stalker, Phillips, and Pemberton (1939), 113 patients out of 2,500 had more than one primary. Their average age was 59·7 years. No example was found in children. Epiblastic and mesoblastic tumours were rarely found together.

American series tend to show higher figures than the London survey. For example, a survey of 2,829 autopsies (Warren and Ehrenreich, 1944) produced an incidence of 6 per cent., and Slaughter (1944), in an analysis of a large series of published surveys, found an incidence of 3·9 per cent. for all cancer cases; none of them were cases of optic nerve tumour or multiple primaries in childhood.

The question arises whether the original radio-therapy given to the orbit after the tumour had been apparently completely removed, could have been in any way connected with the appearance of the very unusually malignant meningioma 5 years after cessation of treatment. In view of the severe *x*-ray burn of the face involving the orbital margin in the area of origin of the second tumour and the rarity of multiple primary tumours in children, this must

certainly be considered as a possibility. Since gliomata of the optic nerve are benign and of low radio-sensitivity it is not usual to treat the area as a prophylactic against recurrence. We can find no recorded similar case. Indeed, it is not easy to find any cases of second primary tumours arising in irradiated areas. Harnett (1952) quotes the following cases without comment; in two of them at least, the second primary appeared within the area irradiated for the first.

(1) **Female, aged 41.**—Carcinoma of pyriform fossa treated by radiotherapy unsuccessfully. At autopsy a squamous carcinoma was found at commencement of oesophagus.

(2) **Female, aged 62.**—Successfully treated by radium for a growth of the floor of the mouth. 42 months later a squamous carcinoma (from which she died) appeared on the posterior third of the tongue.

(3) **Female, aged 68.**—Rodent ulcers of the skin of the nose and orbital region were successfully treated by radium on two occasions at an interval of 9 years; 13 years later she died of cancer of the lung.

(4) **Female, aged 69.**—A local recurrence following a radical mastectomy was treated by radiotherapy; 6 years later she died of cancer of the pylorus.

(5) **Male, aged 48.**—Rodent ulcers on both ears treated by excision and surface radium; 2 years later he died of carcinoma of a bronchus.

(6) **Male, aged 74.**—Growth of tongue treated by *x*-rays and radium; 1 year later growths appeared simultaneously on upper and lower lips; these were treated again with *x*-rays and radium, but he died of cervical secondaries.

(7) **Male, aged 72.**—Carcinoma of tongue excised, 7 months later treated by radiotherapy, and a rodent of the cheek by *x*-rays; 2 years later a third growth appeared on the tongue. Recurrence cannot be excluded.

(8) **Male, aged 65.**—Epithelioma of tongue treated by excision; 1 year later rodent ulcer of the ear treated by radium; 1 year after this epithelioma of the lip appeared.

Again, in this series, the age is high and the tumours all epithelial in origin. The carcinogenic action of the radiotherapy in some of them cannot be excluded, but is not as likely as in our case, which combines several rare features; namely, the occurrence of multiple primaries in a child, the occurrence of a second primary (meningioma) following a glioma of the optic nerve, the unusually high malignancy of the latter, and the occurrence of the second primary within the irradiated area.

Summary

A case is described in which a glioma of the optic nerve was successfully removed from a patient aged 3 years. Irradiation, which was presumably given to prevent recurrence, led to a wide-spread *x*-ray burn, and was followed 6 years later by a highly malignant meningioma involving the frontal bone, from which the child died.

REFERENCES

DUKE-ELDER, S. (1940). "Text-book of Ophthalmology", vol. 3, p. 3098. Kimpton, London.
HUDSON, A. C. (1912). *Roy. Lond. ophthal. Hosp. Rep.*, **18**, 317.
MATHEWSON, G. A. (1930). *Amer. J. Ophthal.*, **13**, 880.
MYERSON, P. G. (1942). *J. Neuropath.*, **1**, 406.
PAGENSTECHER, A. H. (1902). *v. Graefes Arch. Ophthal.*, **54**, 300.
HARNETT, W. L. (1952). "A Survey of Cancer in London". British Empire Cancer Campaign, London.
SLAUGHTER, D. P. (1944). *Int. Abstr. Surg.*, **79**, 89.
STALKER, L. K., PHILLIPS, R. B., and PEMBERTON, J. DE J. (1939). *Ibid.*, **68**, 595.
WARREN, S., and EHRENREICH, T. (1944). *Cancer Res.*, **4**, 554.

Brit. J. Ophthal. (1953) 37, 763.

THE LEGEND AND SHRINE OF SAINT TRIDUANA*

BY

JOHN FOSTER

Leeds

A familiar feature in the eye hospitals of the Mediterranean littoral is the statue or picture of St. Lucia of Syracuse, holding her eyes on a plate. This stylized portrayal dating back to the 12th century is based on the legend that " when pestered by a would-be suitor she performed an auto-evulsion of her eyes and sent them to him "—a literal translation into action of St. Matthew, chapter 18, verse 9. It might be added that while this legend is not given in the catholic encyclopaedia, and at least one student of St. Lucia's iconography regards it as a later accretion due to confusion with the Beata Lucia Casta of Jerez, it appears to be this story which has made her the patron saint of ophthalmology in that part of the world.

It is interesting that the same legend, though very much less widely known, is recorded of a Scottish saint, and that there is evidence that her shrine still exists near Edinburgh.

The literature of the legend is extremely exiguous, the sources of my information being Baring Gould (1872–89), Burnett (1908), and the present incumbent, the Rev. Robert Black Notman, B.D.

According to the breviary of Aberdeen, the blessed and gracious virgin, Saint Triduan, was born at Colosse and landed in Scotland from Constantinople in the company of Saint Regulus or Rule about A.D. 337. These saints brought with them the relics of Saint Andrew, the patron saint of Scotland, an event for ever commemorated by St. Andrews on the coast of Fife.

Subsequently (whilst living an eremitic life with other virgins at Rescoby in Forfarshire), as she was of illustrious birth, of an elegant form, and by nature of a pre-eminently virtuous disposition, Saint Triduan attracted the attentions of the local prince, Nectaneus or Nectan, who desired to marry her. She questioned the messenger sent to her by the Prince, and hearing that he was chiefly attracted by the transcendent beauty of her eyes, she replied, " What he asks of me he shall obtain "; and retiring into a secret place she plucked out her eyes, transfixed them on a wooden pin, and held them out to the messenger, saying, " Accept what your prince desires ". Thereafter she made her abode at Lestalryk, *i.e.* Restalrig in Lothian, some 2 miles from Edinburgh, where she devoted the rest of her life to fasting and prayer.

*Received for publication May 15, 1953.

Between this early legend and the earliest mention of a shrine of Saint Triduana, a long lapse of time occurs, for the next information available comes from the chartularies of the Priory of St. Andrews, which mention the church of St. Triduana at Restalrig in 1178. The golden years of the little church began in 1477, when James III of Scotland made it a Chapel Royal by endowing a chaplaincy, and 11 years later Pope Innocent VIII granted the petition of the same king that the church at Restalrig be erected into a Collegiate church with eight Prebendaries under a Dean. Further endowments in 1496 and 1527 came from James IV and V. Unfortunately, no description of the building itself has come down to us, but apparently it had 32 altars, including a shrine of Saint Triduana. In 1545 it is recorded that a sacrist received " a chamber and garden beside the church with the offerings made to the altar to maintain the lower aisle of the church, the altar of Saint Triduana therein situate, the books, wax candles, and other necessaries ".

A verse from a poem by Sir David Lyndsay (1486–1555) suggests that about this time the shrine was a popular place of pilgrimage. His corruption of the name to Tredwells (later still Traddles) is interesting as conveying the first suggestion of a well.

> It was too lang for tyll discryfe
> Sanct Francis with his woundes fyfe
> Sanct Tredwells als there may be sene
> Quelk on ane prik hath both hir ene . . . .
> . . . . . .
> To Sanct Tredwell to mend their eine.

The shadows were gathering around the church, however; Dr. John Sinclair, who became dean in 1545, was described by one of his contemporaries as " a worldly wise man and not ungodly in understanding the truth ", but he excited very different feelings in the breast of John Knox, the outspoken reformer, who wrote of " that perfyt hypocryte John Sinclare . . . . . blind of ane eie in his body, but of boith in his saule ". As the present incumbent of Restalrig writes: " it is interesting to speculate what part this personal antipathy played in the utter destruction of the fabric ", for in 1560 one of the first decrees of the general assembly of the Presbyterian Church of Scotland was that: " the Kirk of Restalrig as a monyment of idolatrie be raysit and utterly casten downe and destroyed ". This edict was carried out almost to the letter, for, with the exception of the East window and the walls of the chancel, the stones were carried away to rebuild the Netherbow port (gate) of Edinburgh city. For nearly 300 years the church remained a gaunt ruin; one engraving shows one corner only standing, and nearby the hexagonal building, then believed to be a chapter or assembly house, although such would be unusual in a collegiate church.

In 1837 the church was rebuilt by the Restalrig Friendly Society and passed into the hands of the Established Church of Scotland. At this time the hexagonal building, which was believed to be a chapter house or mausoleum,

was roofless and filled with earth to a height of 12 ft. In 1907 the earth was excavated at the instance of the Earl of Moray, on whose land the chapel stood, and according to Ross (1912) an attempt was made to asphalt the floor to exclude a constant rise of water. Finally it became obvious that this was impossible as the rise was due not to seepage, but to a spring under pressure, and the floor remained covered by a foot of water. It then became apparent that the building closely resembled the well-house of St. Margaret nearby, that a built-up arch 12 ft. high on the north side had probably led into the church, and that, therefore, the building had originally been the well-house and chapel of the Blessed Virgin of Lestalryk. The roof was repaired and a statue of the Saint holding a thorn bush with her eyes transfixed on the branches was mounted thereon (Figure), but the statue is now so smoke-blackened that details are not clearly perceptible. About half a mile away stands the Roman Catholic church of Saint Triduana, from which processions are made to the well on her holy day, October 8.

If we accept the legend, it would appear, by analogy with that of Saint Lucia, that British ophthalmologists can claim a patron saint of their own.

FIGURE.—Statue of St. Triduana. The original photograph has been touched up to show the blurred outlines more clearly.

REFERENCES

BURNETT, W. (1908). "Transactions of the Scottish Ecclesiological Society, 1907–8", **2**, (Part 2), 275.

GOULD, S. BARING (1872–89). "The Lives of the Saints", 17 vols. Hodges, London.

LYNDSAY, D. (1931–36). "Works", 4 vols, ed. by D. Hamer for the Scottish Text Society. Charteris, Edinburgh.

NOTMAN, R. B. (1937). "Restalrig Parish Church. A Short Account of its History and Traditions". Law, Leith.

ROSS, T. (1912). "Transactions of the Edinburgh Architectural Association for 1908–1909", **7**, 55.

CORRESPONDENCE

PENETRATING CORNEAL GRAFT

To the Editorial Committee of the BRITISH JOURNAL OF OPHTHALMOLOGY

DEAR SIRS—In your issue of September, 1953, Mr. I. C. Michaelson draws timely attention to the difficulty of even penetration by the trephine into the anterior chamber in full-thickness keratoplasty. Michaelson turns this difficulty to advantage by placing the initial area of penetration according to various pathological conditions of the host cornea (*B.J.O.*, 1953, **37**, 562).

The ideal of even and simultaneous penetration of the anterior chamber by the trephine at right angles to the horizontal corneal plane is rarely achieved with safety. It is assisted by the use of a very sharp trephine which does not cause the host eye to rotate even when the cornea is thick and irregular, by firm fixation with multiple tooth forceps, such as the Barraquer pattern, and by smooth, light, and even finger-and-thumb rotation of the trephine.

We have found further assistance at East Grinstead by a simple manoeuvre which we think is worth putting on record.

When the trephine has been accurately centred on the host cornea, before rotation is begun, the assistant crooks an index finger over the end of the trephine, in line with its body and with the centre of the host cornea. However the eye tends to deviate from position during rotation of the trephine, the assistant's finger always maintains position in line with the centre of the cornea, and the surgeon is thus able to see at once if his trephine is not being maintained at strict right angles to the plane of section. It is easy to correct this adjustment by keeping the trephine always in line with the finger above it. It has been found that about five-sixths of the circumference of the graft section is constantly cut by this simple aid. The remainder is completed by the Arruga knife, taking care not to cut a shelf, or by the Rycroft scissors. Since the best section is made by the trephine, as much as possible of the circumference should by cut by rotation of the trephine, which should never be lifted until the anterior chamber is opened. When such a section is combined with a punch graft an accurate fit is obtained without shelves or tags.

Yours faithfully,

B. W. RYCROFT.
G. J. ROMANES.

CORNEO-PLASTIC UNIT AND REGIONAL EYE BANK,
QUEEN VICTORIA HOSPITAL,
EAST GRINSTEAD, SUSSEX.

September 18, 1953.

BOOK REVIEWS

Tumours of the Orbit. BY R. G. INGALLS. 1953. Pp. 410, 140 figs. Thomas, Springfield, Ill., U.S.A., and Blackwell Scientific Publications, Oxford. (83*s.*)

This book on orbital tumours and " pseudo-tumours " comprises a readable and instructive analysis of 216 eye histories, the material for most of which was gathered from the pathological laboratories of the Institute of Ophthalmology of the Presbyterian Hospital, New York. Each type of tumour affecting the orbital tissues or its walls or invading it from neighbouring parts receives a chapter to itself; each is discussed under the headings of aetiological factors, anatomical location in the orbit, general appearance and behaviour,

symptoms to which it gives rise, and histological characteristics and each chapter contains a series of well-illustrated and fully annotated case reports and a summary of recent literature. The result is an instructive book, the richer because of the large amount of space devoted to the personal experience of the author. The illustrations, particularly the photo-micrographs, are abundant and unusually good, and a useful bibliography is appended.

Le gliome de la rétine et les pseudogliomes. Etude clinique, génétique, et thérapeutique. By Marc-Adrien Dollfus and Bertranne Auvert. 1953. Pp. 521, 9 plates, 101 figs. Masson, Paris. (*Frs* 3,300; 68*s*.)

The conception and practice of the French Ophthalmological Society in setting each year a subject for a report is admirable. Such a report is published before the Society's annual congress at which its authors read a resumé of their work. Since 1926 the Society has produced a succession of excellent monographs of the highest quality, and to this distinguished series of reports is now added the work of Dr. Dollfus on retinoblastoma and Dr. Auvert on pseudoglioma. Their contribution covers most thoroughly all the literature and they add to this a wealth of material from their own extensive experiences in large clinics in Paris. This monograph contains much of academic and clinical interest and the authors are to be congratulated on their industry in collecting data through communications with ophthalmologists all over the world, on the excellent arrangement of their material, and on their choice of illustrations. Their labours have clearly earned them an exalted place both as ophthalmologists and as participants in the splendid series of the Society's publications.

Their monograph is, and will remain, a most important source of reference concerning such tragic ocular diseases as retinoblastoma and the pseudogliomas.

It is produced in the style which is characteristic of the good work of Masson et Cie.

William Cheselden. By Sir Zachary Cope. 1953. Pp. 112, 24 figs, 60 refs. Livingstone, Edinburgh. (20*s*.)

William Cheselden (1688–1752), one of the great London general surgeons of his generation, will always be remembered in ophthalmology as being the first to devise and practise the operation of iridotomy for an occluded pupil; nor was this the only original contribution of note he made to surgery. His life story has been recently told in a delightful book by Sir Zachary Cope, who chose this subject for his Vicary Lecture at the Royal College of Surgeons in October, 1952. Cope devotes a chapter of this monograph to Cheselden's ophthalmological activities; and interesting reading it is. There is a good description of Cheselden's technique for the couching of cataract in 1725 (Daviel did not publish his description of extraction until 1748). At this time the general view was that cataract was a film in front of the lens; but Cheselden dissected an affected eye and satisfied himself that the disease comprised an opacity of the entire lens.

A human touch, not without interest, concerns the capsule of the lens: in the first edition of his famous " Anatomy " Cheselden stated that the lens had no covering capsule, and a certain Dr. Kennedy called on the surgeon at his home to satisfy him that a capsule was in fact present. Kennedy wrote " that he made no great reply thereto, but that he colour'd ". In later editions Cheselden altered his description of the lens, but his informant complained that he had made no acknowledgement of the source of his information.

The book is worth reading if only for Cheselden's descriptions of the " Observations made by a young Gentleman who was born blind, or lost his sight so early that he had no remembrance of ever having seen, and was couched between thirteen and fourteen years of age ". Looking at paintings, the boy " was amazed when he found those parts, which by their light and shadow appeared now round and uneven, felt only flat like the rest, and asked which was the lying sense, feeling or seeing? "

Einführung in die Augenheilkunde. (Introduction to Ophthalmology.) By P. A. Jaensch. 1953. Pp. 244, 197 figs, Georg Thieme Verlag, Stuttgart. (*DM* 22).

This is a short, standard students' text-book of ophthalmology written in German; the first edition appeared in 1946. The arrangement follows conventional lines: a chapter on anatomy is followed by chapters on physiology, optics, and embryology, whereafter succeeding chapters deal systematically with the diseases of the eye, its adnexa, and its central nervous connections. The presentation is clear, the subject matter well chosen and concisely discussed, and the printing and illustrations excellent. For the junior student who is at home with German this short hand-book will be found admirable.

Books Received

Strabismes et paralysies. Clinique et thérapeutique. J. Malbran. 1953. (French translation by Georges Sevrin). Pp. 693, 221 figs, 412 refs. Editions Héraly, Charleroi.

This is a translation from the original Spanish publication which was reviewed in *Ophthalmic Literature* (1949), **3**, 3055.

NOTES

XVII International Congress of Ophthalmology

Montreal and New York, 1954

The Treasury has granted dollar exchange for a limited number of delegates from the United Kingdom to attend the XVII International Congress in North America; allocations will be made by a joint committee appointed by the Councils of the Ophthalmological Society of the United Kingdom and the Faculty of Ophthalmologists. Intending delegates requiring dollar exchange should write to Miss Mary Morris, 45, Lincoln's Inn Fields, London, W.C.2, before March 1, 1954, after which date the Committee cannot entertain further requests for allocations.

Vienna Ophthalmological Society

The Vienna Ophthalmological Society will celebrate their Fiftieth Anniversary on June 21-22, 1954. All ophthalmologists are cordially invited to attend. Further details will be announced at a later date.

Mr. B. W. Rycroft, F.R.C.S., has accepted an invitation from the Ophthalmological Society of South Africa to deliver a series of lectures on plastic surgery and the eye.

OBITUARY

ARTHUR GREENE

Arthur Greene died at Cromer on October 20, aged 77 years. A member of an old Irish family, he qualified in Dublin in 1898, and took his Irish fellowship 10 years later. He came to Norwich in 1903, and was the first specialist to be appointed to the staff of the Norfolk and Norwich Eye Infirmary as a full-time ophthalmic surgeon. During the first world war he saw service in France, and was for some time Ophthalmic Surgeon to the Fifth Army. He held his appointment in Norwich for 37 years, and it was largely due to his efforts that the old Eye Infirmary in Pottergate was moved to a more suitable site opposite the hospital in 1912, and was later amalgamated with the Norfolk and Norwich Hospital.

INDEX TO VOLUME XXXVII, 1953

AUTHOR INDEX

PAGE

Agarwal, L. P.: Curare and curare-like products in cataract sugery 558
———: Tissue therapy in parenchymatous xerosis 102
———, **and Sharma, C. K.:** Two provocative tests for glaucoma 330
Ainslie, D.: Treatment of corneal infection with *Ps. pyocyanea* by subconjunctival injection of polymixin E 336
Ainslie, J. P.: *See* Mann, Ida; Yates, P. C. and Ainslie, J. P.
Amsler, Marc: Earliest symptoms of diseases of the macula 521
Anderson, J. Ringland: Causes and treatment of congenital eccentric nystagmus 267
Asher, H.: Suppression theory of binocular vision 37
Ashton, Norman: Arteriolar involvement in diabetic retinopathy 282
———: Central areolar choroidal sclerosis. A histopathological study 140
——— **and Cook, Charles:** Mechanism of corneal vascularization 193
———; **Ward, Basil, and Serpell, Geoffrey:** Role of oxygen in the genesis of retrolental fibroplasia. A preliminary report. 513
——— **and Smith, Redmond:** Anatomical study of Schlemm's canal and aqueous veins by means of neoprene casts. III. Arterial relations of Schlemm's canal 577
———: *See* Duke-Elder, Stewart, Ashton, Norman, and Brihaye-van Geertruyden, M.

Barling, G. M.: Unusual case of intra-ocular foreign body 116
Beeson, E. J. G.: *See* Hansell, Peter, and Beeson, E. J. G.
Bembridge, B. A., and McMillan, J.: Malignant melanoma occurring after evisceration ... 109
Blaxter, P. L.: Bulbar pressure test in glaucoma 641
Briggs, Allan H.: Mandibulo-facial dysostosis 171
Brihaye-van Geertruyden, M.: *See* Duke-Elder, Stewart, Ashton, Norman, and Brihaye-van Geertruyden, M.
Browne, R. C.: *See* Smith, Arthur, and Browne, R. C.
Bücklers, Max.: Changes in refraction during life 587
Budden, F. H.: *See* Davenport, R. C., and Budden, F. H.

Cagianut, B., and Wunderly, C.: Protein studies on the human vitreous body 229
Choyce, D. P., and Cross, A. G.: An eye sanatorium. Survey of one year's work 405
———: *See* Cross, A. G., and Choyce, D. P.
Clarke, Edwin: Plasma cell myeloma of the orbit 543
Cook, Charles, and Langham, Maurice: Corneal thickness in interstitial keratitis 301
———: *See* Ashton, Norman, and Cook, Charles
Crerar, J. W., and Ross, J. A.: John Dalton, F.R.S., D.C.L., LL.D., Captain Joseph Huddart, F.R.S., and the Harris family. Historical notes on congenital colour blindness 181
Crick, R. P.: *See* Sorsby, Arnold, and Crick, R. P.
Cristini, G., and Pagliarani, N.: Amyl nitrite test in primary glaucoma 741
Cross, A. G.: Sarcoidosis of the eye 247
——— **and Choyce, D. P.:** Unusual appearance in a case of Eales's disease 314
———: *See* Choyce, D. P., and Cross, A. G.

Davenport, R. C., and Budden, F. H.: Loss of sight following snake bite 119
Dobree, J. H.: Vascular changes that occur during phasic variations of tension in chronic glaucoma 293
Duke-Elder, Stewart, Ashton, Norman, and Brihaye-van Geertruyden, M.: Toxoplasmosis in the adult 321

Eames, Thomas H.: Correspondence between visual acuity, refractive error, and the speed of visual perception 312
El Bayadi, George: New method of slit-lamp micro-ophthalmoscopy 625
Esposito, Albert C.: Modification of Bell's erisophake... 61
Evans, P. Jameson: *See* Rudd, C., Evans, P. Jameson, and Peeney, A. L. P.

PAGE

Forgács, Joseph: *See* Weinstein, Paul, and Forgács, Joseph
Foster, John: Table viewer as an aid to clinical demonstration 251
———: The legend and shrine of Saint Triduana 763
———: Variant of the Lancaster diplopia test 378
François, J., and Rabaey, M.: Histopathological examination of a bilateral symmetrical cyst of the retina 601
Fraser, H.: Subconjunctival injection of polymixin B 369

Gilbert, M.: Definition of visual acuity 661
Ginsborg, B. L.: Small voluntary movements of the eye 746
Girgis, A. M.: Intra-ocular operations in Egypt 185
Go, K. H.: Exudation and absorption mechanisms of the normal conjunctival capillaries ... 50
Gordon, Dan M., McLean, John M., and Koteen, Herbert: Present status of corticotropin (ACTH), cortisone, and hydrocortisone in ophthalmology 85
Gourlay, J. S.: *See* Hubbersty, F. S., and Gourlay, J. S.
Greaves, D. P., and Perkins, E. S.: Influence of the third cranial nerve on intra-ocular pressure 54

Hansell, Peter, and Beeson, E. J. G.: Retinal photography in colour 65
Harrison, E. R.: Visual acuity and the cone cell distribution of the retina 539
Hill, James: Congenital toxoplasmosis 689
Howells, Leonard H.: Ocular complications of diabetes mellitus 716
Hubbersty, F. H., and Gourlay, J. S.: Secondary glaucoma due to spontaneous rupture of the lens capsule 432
Hudson, J. R.: Ocular findings in haemochromatosis 242
Hunter, Donald, and Lister, A.: Mercurialentis 234

Jackson, C. R. S.: Standardized tonometers in Great Britain... 694

Kerkenezov, N.: Panophthalmitis after a blood transfusion. Responsible organism *Bacillus cereus* 632
Klein, M., and Millwood, E. G.: Control of experimental corneal infection with medicated semi-solid contact cap and disk. Infection with *Ps. pyocyanea* treated with streptomycin 30
Kornblueth, Walter, and Stein, Richard: Sympathetic ophthalmia following an operation for retinal detachment... 755
Koteen, Herbert: *See* Gordon, Dan M., McLean, John M., and Koteen, Herbert

Langham, Maurice: Observations on the growth of blood vessels into the cornea. Application of a new experimental technique 210
———: *See* Cook, Charles, and Langham, Maurice
———: *See* Lister, A.; Philps, A. S., and Langham, Maurice
Larsson, Sven: Notes on ophthalmological practice in Lund 257
Law, Frank W.: Ocular reaction to lens protein. A preliminary study 157
Lister, A.: Experiences with the Lindner-Guist operation 305
———: *See* Hunter, Donald, and Lister, A.
———, **Philps, A. S., and Langham, M.:** The measurement of corneal thickness and its application to keratoplasty 436
Lloyd, Ivor: Preparation of egg membrane for keratoplasty 503

McAuley, F. D.: Cataracts in galactosaemia 655
MacDonald, Marguerite: *Ps. pyocyaneus* eye infection... 370
McLean, John M.: *See* Gordon, Dan M., McLean, John M., and Koteen, Herbert
McMillan, J.: *See* Bembridge, B. A., and McMillan, J.
Mann, Ida, Yates, P. C., and Ainslie, J. P.: Unusual case of double primary orbital tumour 758
Marshall, M. F. P.: Infra-red image converter in rod scotometry 316
Michaelson, I. C.: Penetrating corneal graft. Orientation of the initial penetration of the trephine into the host cornea 562
Miller, S. J. H.: Intra-ocular pressure in primary congestive glaucoma 1
———: Stellate ganglion block in glaucoma 70
Millwood, E. G.: *See* Klein, M., and Millwood, E. G.

PAGE

Naccache, R.: Topical use of terramycin ointment in trachoma 106
Naylor, E. J.: Polarized light studies of corneal structure 77
Neely, J. C.: A speed-of-perception measurement apparatus 439
Nordlöw, W.: Age distribution of the onset of esotropia 593
North, D. P.: Ocular complications of mumps 99
Nutt, A. B.: Lens extraction in diabetic patients 725

Örgen, Cahid: Chronic progressive external ophthalmoplegia 365

Padgham, C. A.: Quantitative study of visual after-images 165
Pagliarani, N.: *See* Cristini, G., and Pagliarani, N.
Parry, H. B.: Degenerations of the dog retina. I. Structure and development of the retina of the normal dog 385
———: ———. II. Generalized progressive atrophy of hereditary origin 487
———: ———. III. Retinopathy secondary to glaucoma 670
Parsons-Smith, Gerald: Activity of the cerebral cortex in amblyopia... 359
———: Flicker stimulation in amblyopia 424
Patel, V. P.: The Ridley intra-ocular acrylic lens. A simplified operative technique ... 423
Paul, Milroy: Excision of a large orbital dermoid cyst 114
Peeney, A. L. P.: *See* Rudd, C., Evans, P. Jameson, and Peeney, A. L. P.
Perkins, E. S.: *See* Greaves, D. P., and Perkins, E. S.
Philps, A. S.: *See* Lister, A., Philps, A. S., and Langham, M.

Qadeer, S. A.: Grattage in the treatment of trachoma... 621

Rabaey, M.: *See* François, J., and Rabaey, M.
Reed, Howard, Spiro, I., and Wilson, B. D. R.: Osteomyelitis of the maxilla in infants ... 629
Rodger, F. C.: Experimental thiamin deficiency as a cause of degeneration in the visual pathway of the rat 11
Romanes, G. J.: Treatment of established symblepharon with split skin homograft ... 236
Ross, J. A.: *See* Crerar, J. W., and Ross, J. A.
Rossi, Antonio A.: Structure of the vitreous body. Observations by means of the phase-contrast microscope 343
Rudd, C., Evans, P. Jameson, and Peeney, A. L. P.: Ocular complications in thalassaemia minor 353
Ryan, Hugh: Intra-orbital meningioma of the optic nerve 506
Rycroft, B. W.: Instrument inspection clamp 508
———: The Corneal Grafting Act, 1952 349

Sarkies, J. W. R.: Primary glaucoma amongst Gold Coast Africans 615
Scott, G. I.: Ocular complications of diabetes mellitus 705
Scott, J. Graham: Spontaneous rupture of the lens capsule 58
Serpell, Geoffrey: *See* Ashton, Norman, Ward, Basil, and Serpell, Geoffrey
Shapland, C. Dee: Scleral resection—lamellar or penetrating? 177
Sharma, C. K.: *See* Agarwal, L. P., and Sharma, C. K.
Sheridan, Michael: *See* Sorsby, Arnold, and Sheridan, Michael
Simpson, G. C.: Ocular haloes and coronas 450
Smith, Arthur, and Browne, R. C.: Binocular vision of miners with nystagmus 609
Smith, Charles: Staining of toxoplasma in histological sections 504
Smith, Redmond: Crater-like hole in the optic disk 122
———: *See* Ashton, Norman, and Smith, Redmond
Sorsby, Arnold, and Crick, R. P.: Central areolar choroidal sclerosis... 129
——— **and Sheridan, Michael:** Changes in the refractive power of the cornea during growth. Observations on the rabbit 555
Spiro, I.: *See* Reed, Howard, Spiro, I., and Wilson, B. D. R.
Stallard, H. B.: Anterior flap sclerotomy with basal iridencleisis 680
———: Technique of lamellar scleral resection 223
Stanton-Cook, L.: Injury simulating congenital anomaly 188
Stein, Richard: *See* Kornblueth, Walter, and Stein, Richard
Summerskill, W. Hedley: Modification and defence of the scleral implant 415
Swartz, J.: Retro-corneal hyaline bands in interstitial keratitis 374
Symons, H. M.: Early retinal detachment 376

PAGE

Velzeboer, C. M. J.: Ocular manifestations in Löffler's syndrome 731

Ward Basil: *See* Ashton, Norman, Ward, Basil, and Serpell, Geoffrey
Weale, R. A.: Spectral sensitivity curves and the absorption of light by the ocular media ... 148
Weinstein, Paul, and Forgács, Joseph: Venous pressure and ocular tension. Data concerning the diurnal variation of ocular tension 444
Williamson-Noble, F. A.: Detection of glaucoma in general practice 565
Wilson, B. D. R.: *See* Reed, Howard, Spiro, I., and Wilson, B. D. R.
Wunderly, C.: *See* Cagianut, B., and Wunderly, C.

Yates, P. C.: *See* Mann, Ida, Yates, P. C., and Ainslie, J. P.

SUBJECT INDEX

PAGE

Abscess, corneal 34, 342
Absorption mechanisms of conjunctival capillaries 50
Acetylcholine in maculopathy 534
——, quinine and 678
Acne rosacea 206
ACTH, ... 85
——, dosage 96
—— in Löffler's syndrome 733
—— in myelomatosis 548
—— in sarcoidosis 250
——: *See* Cortisone
Acuity gradient, visual 538, 539
——, visual: *See* Visual acuity
Adrenaline, action of dionine and, on conjunctival capillaries ... 51
——, adjunct to streptomycin 36
——, conjunctival capillaries and ... 51
——, streptomycin and 36
"Aerosporin" 371
——: *See* Polymixin
After-images, visual 165
Akinesia 259
Alginate cap in corneal infection 31, 32
Allergy 731
——, cortisone and 88, 92
——, lens protein and 157
——, local lid 92, 94
——: *See* Anaphylaxis; Löffler's syndrome
Alloxan, corneal thickness and 207, 210, 211
——, —— metabolism and 216
——, diabetes and 658
Alpha rhythm 424, 429
Amblyopia 359, 424
——, cerebral cortex in 359
——, diabetes and 713
——, EEG in 359, 424
——, epilepsy and 360, 363
——, flicker stimulation in 424
——, nutritional... 11
——, quinine 678
——, tobacco 713
Amino acids, deficiency of 205
—— ——, vitreous body and 232
Amyl nitrite test in glaucoma 741
Anaemia, Coolley's 353
——, Mediterranean 353
—— ——: *See* Thalassaemia
——, sickle cell 353
Anaesthesia, *in diabetics* *718*
——, "Myanesin" 186
Anaphylaxis, lens protein and 60, 159, 160, 435
Aneurysm 196, 220, 243
Anisometropia 591
Anoxaemia, *nystagmus and* ... *273, 282*
——, ocular tension and 299
Anoxia, capillary growth and ... 194, 204
——, retrolental fibroplasia and ... 518

PAGE

Antibiotics in corneal infection ... 30
—— in osteomyelitis 630
Anticonvulsants in epilepsy 363
Anticutin 250
Antihistamine with cortisone 92

Appliances:
Apparatus for measuring corneal thickness 437
Apparatus for measuring speed-of-perception 439
Bell's erisophake modified 61
Infra-red image converter in rod scotometry 316
Instrument for preparation of egg membrane 503
Instrument inspection clamp 508, 700
Scleral marker 224
Scotoma detector 566
Standardized tonometer in Great Britain 694
Suture retention coil 225
—— tying forceps 226
Table viewer, aid to demonstration... 251

Aqueous humour, flow of 212, 334, 583, 585
—— ——, —— ——, haemodilution and 334
—— ——, —— ——, in glaucoma 293, 297, 641, 741
——, hypertonicity of 202
——, milky 60
——, "outflow fraction" ... 643, 645
Arterioles in diabetic retinopathy ... 282
—— in —— ——, pathology 284
—— in maculopathy 532
Arteriosclerosis, in choroidal sclerosis 141, 145
—— in diabetes 705
—— in glaucoma 618
Artery, anterior ciliary 577, 580
——, —— conjunctival 581
——, hyaloid 188, 515
——, long posterior ciliary ... 577, 580
——, ophthalmic 140
——, posterior ciliary 141
Ascaris ingestation 732
Ascorbic acid, effect on vascularization 193
Asthma 731
Astigmatism *587*
Atheroma of ophthalmic artery ... 141
Atrophy, choroidal 129
——, gyrate 146
——, retinal 141, 487
Atropine, conjunctival capillaries and ... 51
—— in maculopathy 535
Aureole 451, 465
——: *See* Corona

PAGE

Aureomycin in osteomyelitis 630
—— in pyocyaneus infection ... 30, 342
—— in toxoplasmosis 690
—— in trachoma 621
—— in ——, dosage 622

Bacillus cereus 632, 634
B.C.G. in sarcoidosis 247
Behcet's syndrome 328
Behrmann's locator 262
Bell's erisophake 61
Besnier-Boeck disease: *See* Sarcoidosis
Binocular matching technique 165
—— vision, nystagmus and 609
—— ——, suppression theory 37
Birefringence of cornea 77, 80
Blaskovic's operation 366
Bleb after iridencleisis 686
Blindness complicating snake bite ... 119
—— in Gold Coast 615
Blood pressure, glaucoma and 617
—— transfusion, panophthalmitis after 632
—— vessels, retinal, degeneration and 492, 500
—— ——, ——, development of ... 513
Blood-sugar in diabetes 712
Boeck's sarcoid: *See* Sarcoidosis

Book Reviews:

ADLER, F. H. (editor): Gifford's Textbook of Ophthalmology (1953) 447
AUVERT, BERTRANNE: *See* DOLLFUS, MARC-ADRIEN
BIER, NORMAN: Contact Lens Routine and Practice (1953) 382
COPE, SIR ZACHARY: William Cheselden (1953) 767
COPEMAN, W. S. C.: Cortisone and ACTH in Clinical Practice ... 573
DOLLFUS, MARC-ADRIEN, and AUVERT, BERTRANNE: Le gliome de la rétine et les pseudogliomes. Etude clinique, génétique et thérapeutique (1953) 767
ELLIOTT, FRANK A., HUGHES, B., and TURNER, J. W. A. Clinical Neurology (1952) 447
FOX, SIDNEY A.: Ophthalmic Plastic Surgery (1952) 254
FRIEDENWALD, J. S., WILDER, H. C., MAUMENEE, A. E., SANDERS, T. E., KEYES, J. E. L., HOGAN, M. J., OWENS, W. C., and OWENS, E. U.: Ophthalmic Pathology, an Atlas and Textbook (1952) 126
HUGHES, WILLIAM F.: Office Management of Ocular Diseases (1953) 447
INGALLS, R. G.: Tumours of the Orbit (1953) 766

PAGE

Book Reviews (contd.):

ITTELSON, WILLIAM H.: The Ames *Demonstrations* in Perception (1952) 318
JAENSCH, P. A.: Einführung in die Augenheilkunde (1953) ... 76
LINKSZ, ARTHUR: Physiology of the Eye. *Vol. II.* Vision (1952)... 573
LUNDBAEK, KNUD: Long-Term Diabetes (1953) [Ophthalmology section in collaboration with V. A. JENSEN.] 638
MELCHERS, M. J.: Diathermy Treatment of Intra-Ocular Tumours (1953) 637
NATAF, ROGER: Le trachome (1952) 124
OHM, J.: The Objective Testing of Visual Acuity by Optico-kinetic Nystagmus (1953) ... 638
PASCAL, JOSEPH L.: Selected Studies in Visual Optics (1952) ... 125
SCOBEE, R. G.: The Oculorotatory Muscles (1952) 2nd. ed. ... 510
SEGAL, J.: Le mécanisme de la vision des couleurs (1953) ... 700
VON WINNING, C. H. O. M.: Retrolental Fibroplasia and Other Forms of Pseudo-Glioma (1952) 190
WOLFF, EUGENE: Diseases of the Eye (1953, 4th ed.)... 510

Books reviewed in *Ophthalmic Literature:*

ANDERSON, J. M.: Contact Lenses, Clinical and Other Observations (1952) 126
MALBRAN, J.: Strabismes et paralysies. (trans. G. SEVRIN). (1953) 768

Bowman's membrane 186
Bruch's membrane in choroidal sclerosis 143, 146

Bulbar pressure test: *See* Test

C 10: *See* Decamethonium iodide
Calcification, intracranial ... 689, 692
Calcium in maculopathy 535
Camera, retinal 65
Canthotomy 261
Capillary, conjunctival, exudation and absorption mechanisms ... 50
—— fragility, in diabetes ... 711, 728
—— ——, vitamins and 729
——, intra-ocular, in glaucoma ... 74
—— permeability, cortisone and 92, 208
—— ——, glaucoma and 334
—— ——, relation to antibiotics ... 88
Casts, Neoprene... ... ... 140, 577
——, ——, (figure) facing ... 582, 583

PAGE

Cataract, aetiology 658
——, complications ... 185, 260, 432
——, extraction 157, 160, 260
——, fish-lens treatment of 569
——, hypermature 60, 260, 434
—— in diabetes 711, 712, 721, 725
—— in dogs 488, 498
—— in galactosaemia 655
—— —— ——, histology 657
—— —— ——, metabolic studies ... 658
——, post-operative ...
——, secondary 185
——, senile 59, 712
——, spontaneous absorption of ... 434
—— surgery, bacteriology and... ... 258
—— ——, curare and 558
——, traumatic 59
Cellulitis, orbital... 95
Cerebral calcification, in toxoplasmosis 327
Chamber, anterior, fibrin deposition in 375
—— ——, trephining and 562
Chemosis, in pyocyaneus infection ... 336
Chemotaxis, in corneal vascularization 193
Chloromycetin, in osteomyelitis ... 630
——, in pyocyaneus infection ... 33, 342
Cholinergic drugs, ocular tension and 54, 744
——: *See* Acetylcholine
Chorio-allantoic membrane of chick embryo 505
Choriocapillaris 139, 141, 143
Chorio-retinitis 324
——, cortisone and 91
——, Jensen's 739
——, maculopathy and 530
——, toxoplasmosis and ... 321, 689
Choroid, atrophy of 129
——, central areolar sclerosis of 129, 140
——, detachment of 687
——, meningioma and 507
——, of dog 389, 394
——, retinal degeneration and... 492, 498
——, sclerosis of, age at onset 137
—— ——, clinical course 138
—— ——, diagnosis 138
—— ——, ophthalmoscopic changes ... 137
—— ——, pathology 138
——, slit-lamp examination 625
Choroideremia 146
Choroiditis 99
Ciliary body, hyalinization of 142
Cocaine, conjunctival capillaries and ... 51
Cogan's theory of neovasculogenesis 196, 201, 203, 210
Collagen in corneal structure 82
Colloid structure of vitreous 343
Coloboma 123, 171
Colour blindness 155
—— ——, congenital 181
——, coronas and 470
—— mixture, binocular vision and ... 46
—— photography of retina 65, facing 68
Compactness of cornea: *See* Cogan's theory
Compound E: *See* Cortisone
Compound F: *See* Hydrocortisone

PAGE

Cone density 401, 538
Congenital hole in optic disc 122
Conjugate deviation 275
—— ——, pathways involved 278
Conjunctiva in haemochromatosis ... 243
Conjunctival capillaries, vasomotor control 52
Conjunctivitis, vernal 263
——, ——, treatment facing 264
—— with tuberculosis 412
Conjunctivoplasty in trachoma... ... 102
Contact cap, in experimental infection... 30
—— ——, vehicle for antibiotic ... 31
Cornea, abrasions of, cortisone and ... 93
——, antibiotics in infection ... 30
——, birefringence 77, 80
——, experimental infection ... 30
——, —— vascularization ... 210, 213
——, first-aid treatment after injury ... 35
——, hydration 196, 201, 203, 210, 219
—— in haemochromatosis 243
——, nutrition 50
——, oedema ... 202, 210, 294, 296, 301
——, —— ——, in glaucoma 10
——, —— ——, mechanism 219
——, —— ——, physiological 51
——, opacification 236, 301
——, permeability 218
——, pyocyaneus infection 30, 336, 369, 370
——, refraction at 460
——, refractive power ... 555, 556
——, curvature, in rabbits 557
——, structure, microscopic 78
——, ——, polarized light studies ... 77
——, ——, sub-microscopic 79
——, thickness 212, 301
—— ——, keratoplasty and 436
——, vascularization ... 196, 210, 213
——, ——, cortisone in ... 301, 372
——, —— ——, hyaluronic acid in ... 196
—— —— ——, mechanism 193, 210, 211
Corneal Grafting Act, 1952 349
Corona, ciliary, rays in 479, 481
——, ciliary 450, 451, 476, 483
——, Descartes 451, 474, 483
——, development of 468
——, experimental 464
——, light intensity in 466
——, Lycopodium 464
——, size of 471

Correspondence:

Corneal ulceration with *Ps. pyocyanea* 381
Influence of the cranial nerves on intra-ocular pressure 637
Instrument inspection clamp ... 700
Request for reprints of articles on stress and the adaptive hormones 190
Standardization of reading types ... 253
Technique in trephining 766

PAGE

Cortex, cerebral, amblyopia and
——, ——, electrical activity 359, 362, 424
——, ——, flicker stimulation and ... 424
——, ——, nystagmus and 275
Corticotropin: *See* ACTH
Cortisone 85
——, allergy and 88, 92
——, hydrocortisone and 94
——, complications of 89
——, dosage 96
——, diabetic retinopathy and... ... 290
——, experimental observations ... 92
—— in chorio-retinitis 91
—— in corneal vascularization 196, 205, 207
—— in keratitis 301
—— in Löffler's syndrome 733
—— in myelomatosis 548
—— in ocular tuberculosis ... 408, 410
—— in sarcoidosis 250
—— in sympathetic ophthalmia ... 756
—— in thalassaemia 357
——, long-acting vehicles and 90
——, related compounds 93
——, route of administration 85
——, surgery and 91
Crescents, myopic 131
Crystal formation in vitreous 344
Crystallines: *See* Protein
Curare, in ocular surgery 56, 186, 558
——, pharmacology of 558
" Cushion cells " 290
Cyclodialysis 682, 683
Cyclophoria 378, 380
Cyst, dermoid, orbital 114
——, retinal, pathology of 601
—— of ora serrata 601
——, congenital 606

Dalton, John 181
Dark-adaptation, after-images and ... 167
Dark-room tests in glaucoma 4
Decamethonium iodide, extra-ocular muscles and 56
Decerebration, ocular tension and ... 55
Degeneration, colloid 186
——, conjunctival 186
——, disciform 146, 147
——, hyaline 282
——, retinal, in dogs ... 385, 487, 670
——, ——, microcystoid 606
——, secondary macular ... 145, 147
Demyelinization in thiamin deficiency ... 26
Depth perception with diplopia ... 47
Descartes corona ... 451, 474, 483
Descemet's membrane 205, 206
—— ——, detachment of 688
—— ——, rupture of 202, 374
Diabetes mellitus... ... ... 705, 716
—— ——, alloxan and 211
—— ——, capillary fragility and 705, 712, 713, 716
—— ——, cataract and 658, 712, 721, 725
—— ——, haemochromatosis and ... 245

PAGE

Diabetes Mellitus, lens extraction in ... 725
—— ——, microaneurysms in... ... 243
—— ——, nephrosis and 706
—— ——, refraction and 711
—— ——, retinopathy in ... 282, 719
—— ——, wound healing in 725
Diathermy 265
—— in retinal detachment ... 306, 376
Dibenamine, glaucoma and 70
Diet and visual degeneration 14
Diffraction effects 451
——, *x* ray 77
Dihydrostreptomycin 31
Dionine, conjunctival capillaries and 51
Diplopia 236
——, depth perception with 47
—— in external ophthalmoplegia ... 365
——, Lancaster test 378
Disc, optic, cupping of 618
——, crater-like hole in 122
Disks, gelatine, in corneal infection 31, 32, 33
Disseminated sclerosis, symmetrical nystagmus and 276
Diurnal variation of ocular tension 1, 444
Dog retina 385, 487, 670
Drualt's test 454, 462
Drugs, histiotoxic, in myelomatosis ... 548
Du Tour's theory of binocular vision ... 37
Dynamometer, in glaucoma ... 644, 645
Dysostosis, mandibular-facial, ... 171

Eales's disease... ... 92, 263, 314
Echis carinatus 119
EEG in amblyopia ... 359, 424, 426
—— —— epilepsy 360
Egypt, ocular surgery in... 185
Electrophoresis of vitreous proteins 229, 231
Electroretinogram ... 386, 497, 602, 679
Endophthalmitis, allergic ... 159, 260
—— purulent 435
Eosinophilia 731
——: *See* Löffler's syndrome
Epilepsy, Amblyopia and 360, 363, 424
Episcleritis 95
Erisophake, Bell's 61
Eserine, conjunctival capillaries and ... 51
Esotropia, age distribution ... 593, 594
Evisceration, malignant melanoma after 109
Exophthalmos 95, 380
Extract, corneal 201
Extraction, lens 257, 259
Extra-ocular muscles, effect of C 10 ... 56
Exudates, retinal... ... 285, 288, 708, 722
Exudation mechanisms of conjunctival capillaries 50
Eye, small movements of 746
——, ——, time sequence 748
——, ——, angular pattern 750
——, reaction time of 752

Fellowships 127
Fever therapy 87, 90

PAGE

Fibres, lenticular... 451
——, zonular 346
Fibrillar structures in vitreous 345
Fibrils of cornea... 82
—— in vitreous 229
Filatov: *See* Tissue therapy
Fixation 277
Flicker stimulation, amblyopia and ... 424
—— ——, EEG in 426, 428
Fluid, intra-ocular, formation of ... 74
Foreign body, corneal infection and ... 30, 35
—— ——, intra-ocular 116
—— ——, removal of 262
Fragility, capillary: *See* Capillary
——, erythrocyte 353, 357
Franceschetti's syndrome 171
Friedenwald, J. S. 578
Fundus oculi, biomicroscopy of ... 625
—— —— in choroidal sclerosis ... 130
—— —— in diabetes 705, 716, 720, 721
—— —— in Löffler's syndrome ... 736
—— —— in thalassaemia ... 354, 357
—— —— of dog ... 388, 487, 670
—— ——, photography of 65
—— dystrophy: *See* Degeneration, disciform
Fusion, in binocular vision 37

Galactosaemia, cataract in 655
Gallamine triethiodide 558
Ganglion, ciliary, ocular tension and ... 54
——, stellate, —— —— —— ... 70, 744
Gaze, mechanism of transference ... 746
Gelatine disks: *See* Contact cap
Geniculate bodies, thiamin deficiency and 12, 21, 24
Glaucoma after needling 59
——, bulbar pressure test in 641
——, capillary permeability and ... 334
——, cholinergic drugs and 293
——, clinical features 8
——, diagnostic test 641
—— in dogs 670
—— —— ——, pathology 677
—— in general practice 565
——, intra-ocular capillaries and ... 74
——, paracentesis in 434
——, provocative tests 330, 641
——, scotoma in 565
——, sleep and 299
——, stellate ganglion and 70
——, surgery in 680
——, tonography in 641
——, acute 1
——, ——, cataract and 260
——, ——, emotion and 5
——, ——, precipitating factors ... 3, 9
——, ——, relieving factors 5
——, ——, rupture of lens and... ... 60
——, ——, spacing of attacks 3
——, chronic, vascular changes in ... 293
——, congestive 617

PAGE

Glaucoma, congestive, aqueous veins and 73
——, ——, ciliary congestion and ... 293
——, ——, cf. simple 8
——, ——, emotions and 70
——, ——, haloes and coronas in ... 450
——, ——, mechanism of 299
——, ——, sympathetic and 72
——, primary 1, 741
——, ——, amyl nitrite test 741
——, ——, distribution... 617
——, ——, in Gold Coast 615
——, ——, surgery 618
——, simple, aqueous veins in... ... 73
——, ——, sympathetic and 71
——, secondary 95
——, —— to lens rupture 432
——, ——, differential diagnosis ... 435
——: *See* Tension, ocular
Glioma 758
Glucose, cataract and 658
—— tolerance curve 245
Glutathione, cataract and 658
Glycolysis, corneal 216
Gold Coast, glaucoma in 615
Graft, amniotic membrane, in conjunctival burns 102
——, corneal 436
——, ——, egg membrane and ... 503
——, ——, Parliamentary Act... 349, 351
——, ——, penetrating 562
——, ——, vascularization in 201
——, split skin, in symblepharon ... 236
Grating, optical 451, 456
——, ——, optics of 454, 459
—— pattern 661
Grattage in trachoma 621
Grid, Amsler 524, 525, 526
Growth, corneal refraction and... ... 555
Gullstrand, A. 522

Haemochromatosis 242
Haemodilution, ocular tension and ... 333
Haemorrhage after lens extraction ... 727
—— —— snake bite 119
——, retinal 288, 721
——, ——, in haemochromatosis ... 244
——, vitreous 707, 709, 721
Halo, lenticular 450, 452
——, ——, size of 458, 462
——, ocular 450, 617
Harris family 181
—— ——, pedigree 183
Head tremor, in nystagmus ... 611, 613
Hecht's experiment 42
Heerfordt disease: *See* Sarcoidosis
Herbert pits 186
Heredity in choroidal sclerosis... ... 129
—— in colour blindness 181
—— in diabetes ... 487, 496, 717, 736
—— in nystagmus 267
—— in retinal degeneration ... 487, 496
—— in thalassaemia 353
Hess test 378

PAGE

Hexamethonium, aqueous veins and 297
——, ocular tension and 298
Histamine, corneal vascularization and 194
——, effect on conjunctival capillaries... 51
——, ocular tension and 299
——, venous return and 74

Honours:

CHOYCE, D. P.... 702
DOGGART, J. H. 575
DUKE-ELDER, S. 702
GREGG, NORMAN MCALISTER ... 128
LYLE, T. KEITH 126
NUTT, A. B. 511, 575
RIDLEY, HAROLD 63
RYCROFT, B. W. 768
SAVIN, L. H. 448
SRINIVASAN, E. V. 319

Horner's syndrome 70
Huddart, Joseph 181
Humour, aqueous: *See* Aqueous
——, vitreous: *See* Vitreous
Hyaline bands in interstitial keratitis ... 374
Hyaluronic acid 196
—— ——, in vitreous 233, 347
Hyaluronidase 196, 260
Hydrocephalus, toxoplasmosis and ... 689
Hydrocortisone 85, 93
——, analgesic effect 94
——, dosage 94, 96
——, local lid allergy and 94
——, orbital pseudotumour and ... 95
——, uveitis and... 94
——, vernal catarrh and
——: *See* Cortisone
Hypermetropia 312, 587
—— in diabetes 513
Hyperoxia, developing retina and ... 513
Hypertension, diabetic retinopathy and 720
——, glaucoma and 615, 617
——, intra-ocular ... 434, 677, 678
——: *See* Glaucoma
Hypersensitivity, Löffler's syndrome and 731
—— of lens 260
——, sarcoidosis and 249
Hypoglycaemia, cataract and 658
Hypopyon 95, 260, 434

Implant, lens 423
——, orbital 265, 415, 423
——, scleral 415
——, ——, complications 418
Implantation, delayed 421
Indian ink studies 514, 515, 516, 578
—— —— ——, in diabetes ... 284, 286
Infection after lens extraction 727

PAGE

Infra-red image converter 316
Injury simulating hyaloid artery ... 188
Insulin 718
Iodoform in corneal infection 30
Iridectomy 450
—— in acute glaucoma 7, 618, 653
Iridencleisis, flap sclerotomy and 432, 680, 684
Iridocyclitis 432
——, hyaline bands in 374
—— in diabetes 729
——, post-operative 687, 712
Iris, arterial circle of 577, 580
—— in diabetes 713
—— in haemochromatosis 243
——, rubeosis of... 714
Iritis 60, 159
——, exudative, cataract and 260
Irritation, coronas and 474
Ischaemia, neovasculogenesis and 195, 204
——, retinal degeneration and... ... 677
Isonicotinic acid 92, 413

Jugular compression test 330

Keratectomy 436
Keratic precipitates 248
Keratitis, antibiotics in... 30
—— complicating mumps 99
——, cortisone in 301
——, interstitial 301
——, ——, hyaline bands in 374
——, trachomatous 185
——, treatment of 30, 436
—— with tuberculosis 412
Keratoconus 590
Keratoplasty 102, 349, 436
——, corneal thickness and 436
——, egg membrane and 503
——, lamellar 436
——, penetrating 436, 562
——, technique 562
Kimmelstein-Wilson disease 720
Koeppe, L. 522

Lamp, Xenon 66
Lancaster diplopia test, variant of ... 378
Legend of St. Triduana 763
Lens, contact, in tracing eye movements 746
——, extraction of 713, 725
——, fish 569
——, hydration of 659, 711
—— in galactosaemia 657
—— in haemochromatosis 244
——, luxation of... ... ... 314, 670
——, mercury poisoning of 234
—— opacity 714
—— pigmentation 149
——, structure of 456
—— capsule, rupture of 58, 162, 432

PAGE

Lens protein, allergy to 60, 157
—— ——, ultra-violet absorption spectrum 231
——, Ridley acrylic intra-ocular ... 423
Leucodiapedesis 53
Light, absorption of, by ocular media ... 148
——, polarized, in study of cornea ... 77
Limbus, vessels of, and neovasculogenesis 202, 206
Lindner-Guist operation 305
"Liquid glare" 468
Löffler's syndrome 731
Lund, Sweden, ophthalmology in ... 257
Lung, infiltration of: *See* Löffler's syndrome
Lycopodium corona 465, 483
Lymphogranulomatosis: *See* Sarcoidosis

Macropia, maculopathy and ... 528, 530
Macula, diseases of 521
——, —— ——, pathology 530
——, —— ——, symptoms 523
——, —— ——, treatment 533
——, examination of 525
——, suppression of 610
——, pigment of, in spectral sensitivity 155
Mandibulo-facial dysostosis 171
Mantoux test 405
—— —— in sarcoidosis ... 247, 249
Maxilla, congenital deformity of ... 165
——, osteomyelitis of 629
Melanoma, malignant 109, 244
——, ——, pathology 110, 111
Membrane, egg, keratoplasty and ... 503
Meningioma of optic nerve 506
——, orbital 758
Mercurialentis 234
Metamorphoma (metamorphopsia) 523, 527
Micelles of cornea 82
Mickulicz' disease 247
Microaneurysms, in diabetes 707
——: *See* Aneurysm
Micropsia, maculopathy and ... 528, 530
Microscope, electron 77
——, phase-contrast 343
Middlebrook-Dubos test... 413
Miners, nystagmus in 609
Miotics, in glaucoma 3, 7
Mooren's ulcer 95
Movements, voluntary ocular 746
Mucous membrane, myeloma and ... 552
Mules's implant 415, 417
Mumps, ocular complications of ... 99
Muscle balance, speed of perception and 442
——, extra-ocular, ocular pressure and 56
Myanesin in ocular surgery 186
Myasthenia gravis 366
Myelination of visual pathways 277, 359
"Myelogenesis retardata" 359

PAGE

Myeloma, plasma cell 543
——: *See* Orbit
Myelomatosis, multiple 541
——, ——, treatment 548
Myopia, blood-sugar and 712
——, "endogenous theory" 587
——, crescents in 131

Neoprene studies... ... ... 140, 577
Neovasculogenesis in diabetic retinopathy 196, 214, 284
Nephrosis, diabetes and... 706
Nerve, oculomotor, ocular tension and 54, 56
——, optic, traumata simulating congenital anomaly of 188
Neuritis, retrobulbar 95, 99
Neuropathy, nutritional... 11
Nicotinic acid in maculopathy 534
Night blindness in dogs 487
Nutrition deficiency 11
Nystagmus, abduction, adduction and 609, 612
——, binocular vision and 609
——, convergence and 609, 612
——, fusion angle and 609, 612
——, head tremor and 611, 613
——, stereopsis and 609, 612
——, visual acuity and 610
——, asymmetrical 267, 276
——, congenital 267
——, ——, characteristics 267
——, ——, incidence 268
——, ——, inheritance 270
——, ——, mechanism 274
——, ——, obstetric considerations and 270
——, ——, spontaneous cure 277
——, ——, surgery 278
——, ——, treatment 277
——, symmetrical 276

Obituary:
DICKSON, ROBERT MILNE 128
EDRIDGE-GREEN, F. W. 384
GOULDEN, CHARLES BERNARD ... 703
GREENE, ARTHUR 768
MACMILLAN, JOHN ALEXANDER ... 320
MARSHALL, JAMES COLE 192
MUTCH, JOSEPH RAEBURN 512
PICKARD, RANSOM 256
ROXBURGH, ALEXANDER BRUCE ... 384
WESSELY, KARL 320

Occlusion treatment for amblyopia ... 360
—— —— —— nystagmus 278
——, vascular 145, 195, 282, 518
Ocular media, light absorption and ... 148
Oedema, physiological, of cornea ... 51
Opacification, of cornea... 193, 210, 211
Ophthalmia, purulent 185
——, sympathetic 92. 159, 416, 418, 756

PAGE

Ophthalmology in Sweden ... 257, 756
Ophthalmoplegia 380
——, chronic progressive external ... 365
Optic atrophy due to snake bite ... 121
—— disc, hole in 122
—— —— in glaucoma 1, 8
—— fibres, thiamin deficiency and ... 11
—— ——, —— —— ——, pathology 19, 21, 24
—— nerve, glioma of 758
—— ——, meningioma of 506
—— ——, slit-lamp examination ... 625
—— ——, traumatic rupture of ... 189
—— neuritis 87
—— —— complicating mumps ... 99
' Optimum compression ', in bulbar pressure test 645, 646
Ora serrata, cyst of 601
Orbit, myeloma of 541
——, —— ——, cases reviewed ... 545
——, —— ——, classification... ... 544
—— ——, diagnosis 548
——, —— ——, incidence 544
——, —— ——, pathology ... 547, 551
——, —— ——, treatment 548
——, pseudotumour of 95
——, tumour of, double primary ... 758
Orthoptics in amblyopia 360
—— in nystagmus 278
Oscillation 609
Osmosis, lens hydration and 711
——, relation to cataract 658
Osmotic pressure of blood, ocular tension and 333
Osteomyelitis of maxilla 629
' Outflow fraction ' 643, 645
Oxygen, in genesis of retrolental fibroplasia 513
——, vasoconstrictor effect 518

Palpebrae, fissures of, obliquity of ... 171
Palsy, ocular, in diabetes 713
——, ——, in mumps 100
Pannus, trachomatous 102, 106, 186, 621
Panophthalmitis, *B. cereus* and 632
Panum's experiment 37
Papillitis 99
Paralysis, progressive bulbar 366
Parasympathetic system... 54
Parinaud's syndrome 412
Particles, ocular coronas and size of 464, 465, 472, 479
PAS 406, 408, 413
Pedigrees in choroidal sclerosis 129, 131, 132, 134
Perception, speed of, measurement of... 312
Periarteritis nodosa 439, 733
Peri-orbital injuries, treatment of ... 30
Petit mal, amblyopia and 360
Photography, colour, of retina 65
Pilocarpine, effect on conjunctival capillaries 51
Pischel needles 265

PAGE

Placenta extracts of, subconjunctival ... 102
Plasmacytoma: *See* Myeloma
Pneumonia, Löffler's 731
Polarized light in study of cornea ... 77
Polycythaemia 353
Polymixin 371, 372
——, pyocyaneus infection and 336, 370
——, subconjunctival ... 336, 369, 370
Pons rarolii, nystagmus and 276
Potash in retinal detachment 306
Potassium chloride, in cortisone therapy 91
Pressure, extra-ocular, diagnostic ... 641
——, intra-ocular: *See* Tension, ocular
——, venous, ocular tension and ... 444
Promizol in tuberculosis 406
Prosthesis, ocular 265, 415
Protein, Bence-Jones 543
——, fish-lens 569
——, ——, allergy to 435
——, lens, ocular reaction to 157
——, residual, of vitreous body ... 347
—— studies, on vitreous body... 229, 231
Pseudo-cysts, toxoplasmosis of... ... 327
Pseudotumour, orbital, hydrocortisone and 95
Pseudomonas pyocyanea 30, 91, 336, 369
—— —— infection, ... 336, 369, 370
—— ——, antibiotics in ... 342, 369
—— ——, experimental ... 30, 34
—— ——, from contaminated cortisone 91
Ptosis, in external ophthalmoplegia ... 365

Quinine amblyopia 678

Radiography, bone-free 261
Radiotherapy 263, 548, 758
Radium 264
Rays 472
Refraction changes in diabetes 711
—— —— —— during life 587
——, error in 312
Refractive index of cornea 83
—— power of cornea 555
Resolution, limit of 663
——, television and 665
——, vertical 667
Retina, after-images 165
——, bilateral cysts of 601
——, central lesions of 521
——, cone cells in 538
——, cysts of 606
——, degeneration of ... 487, 606, 670
——, —— ——, tissue therapy in ... 536
——, detachment of 177, 227, 265, 305, 310, 376, 601
——, ——, sympathetic ophthalmia and 755
——, diabetes and 705
——, disinsertion of 607
——, dog, atrophy progressive of ... 487
——, ——, cone density in 401

PAGE

Retina, dog, degeneration of 385, 487, 670
——, ——, —— ——, pathology ... 390
——, ——, development of ... 385, 394
——, ——, glaucoma in 670
——, ——, structure of... ... 385, 389
——, exudates in 708
——, haemorrhage in 606, 721
—— in choroidal sclerosis 143
—— in diabetes 282
—— in haemochromatosis 244
—— in Löffler's syndrome 736
—— in thalassaemia 355, 357
—— in thiamin deficiency 17
——, microaneurysms in 286, 288, 707, 720
——, oedema of 531, 532, 739
——, —— ——, cortisone in 91
——, oxygen and development of ... 513
——, pars ciliaris and 346
——, perforation of 607
—— periphlebitis of 412
——, photography of, in colour ... 65
——, shrinkage of 530
——, slit-lamp examination of... ... 625
——, snake-bite and 121
——, veins of, sympathetic block and... 74
——, vessels of 195
——, —— ——, embryology 513
——, —— ——, in glaucoma 618
Retinitis pigmentosa ... 102, 487, 501
—— proliferans 315, 709, 720
Retinopathy, diabetic 263, 282, 705, 706, 709
——, ——, classification 708
——, ——, cortisone in... ... 92, 290
——, ——, distribution... 706
——, ——, incidence 719
——, ——, pathology 282, 706
——, ——, prevention 719
——, in dogs 385, 487, 670
——, —— ——, glaucoma and ... 670
——, —— ——, virus 679
Retrolental fibroplasia, genesis of ... 513
——, ——, oxygen and 513
Riboflavine, vascular growth and 194, 204
Ridley implant 423
Rings, coloured 450, 452, 454, 465
——, ——, measurement of 485
—— ——: *See* Haloes; Coronas
Ronne's steps 618
Rubeosis of iris in diabetes 714
Rupture of lens capsule 58
Russell bodies 142
Rutin, capillary fragility and 711
—— in diabetes 721, 729

Saint Triduana 763, 765
Salt, loss of 712
Sanatorium, eye 405
—— treatment 250, 405
Sarcoidosis, ocular ... 247, 407, 412
——, ——, aetiology and diagnosis ... 248
Schiötz 54
——: *See* Tonometer

PAGE

Schlemm's canal 75, 645
—— ——, anatomy of 577
—— ——, arterial relations of 577
—— —— in glaucoma ... 293, 297, 298
—— ——, Neoprene casts of 577
Schwann cells, melanoma and 112
Sclera, flap of, with iridencleisis ... 680
——, resection of ... 177, 223, 301
——, —— ——, complications ... 226
Scleritis 95, 99
Sclerotomy 618
—— anterior flap 680
——, —— ——, complications ... 687
Scotoma in glaucoma 565
——, detector 566
—— in macular disease 523, 529, 533
——, sector 618
Scotometry 316
Sensitivity curve, foveal... ... 149, 155
—— ——, spectral 148
—— test, dermal, toxoplasmin... ... 326
—— to lens protein 157, 249
—— —— —— ——, pathology of ... 161
—— —— —— ——, sympathetic ophthalmia and 159, 163
Shropshire, R. R. 569
Slit lamp, micro-ophthalmoscopy with 625
—— ——, new technique with... ... 626
Snake bite, blindness following... ... 119

Societies:

All-India Ophthalmological Society 319
American Ophthalmological Society, Officers, 1953–54 510
British Medical Association. Annual Congress, 1953 574
Concilium Ophthalmologicum Universale, Meeting in Paris, 1953 511
Contact Lens Society, Annual General Meeting, 1953... 255
Faculty of Ophthalmologists Officers,1953–54 447
Study Tours, 1953 639
Latin Congress of Ophthalmology, First, Rome, 1953 702
League against Trachoma 448
International Congress of Ophthalmology, XVI, London, 1952... 64
International Congress of Ophthalmology, XVII, U.S.A., and Canada, 1954 318, 574, 701, 768
International Congress of Oto-Neuro-Ophthalmology, XVIII 127, 448
International Organization against Trachoma, Council meeting, 1953 702
International Symposium on General Physiology and Pathology of the Eye, Iowa, 1954 701
Irish Ophthalmological Society, Annual meeting, 1953 63

PAGE

Societies (*contd.*):
Ophthalmological Society of Australia (B.M.A.), 12th Annual general meeting, 1952 62
Ophthalmological Society of Egypt, Jubilee, 1953 126
Ophthalmological Society of Mexico, Officers, 1953 255
Ophthalmological Society of the United Kingdom
Transactions 191
Index ophthalmologicus ... 255
Annual Congress, 1953 ... 382
Annual Congress, 1954 ... 701
Ophthalmological Society of Vienna, 50th anniversary 768
Order of St. John of Jerusalem ... 127
Oxford Ophthalmological Congress, 1953 63
Royal Eye Hospital Clinical Society 63, 127, 191
South-Western and Southern Ophthalmological Societies 191
University of Toronto, Course in Eye Surgery 64
Vienna Ophthalmological Society ... 768

Spasm, arterial, diabetic retinopathy and 286, 289, 290
——, arteriolar 532
Spectrum 450
Speed-of-perception, measurement ... 439
—— —— ——, muscle balance and ... 442
Spike and wave, EEG forms in amblyopia 359
Squint: *See* Strabismus
Staphylomata, ciliary 315
Stereoscope, colour mixture in... ... 46
Steroid hormone dosage 96
—— —— therapy (Table) 95
—— —— order of use 96
Stevens-Johnson syndrome 95
Strabismus, aetiology of 593
——, amblyopia and 359, 425
——, alternating... 380
——, intermittent 598
—— with nystagmus 280
——, permanent... 596
——, sex distribution 595
Streamers 484
Streptomycin in pyocyaneus infection 30, 342, 373
—— in tuberculosis ... 406, 408, 413
——, topical, penetration into cornea... 34
Sub-retinal fluid in surgery 265, 306, 311
Sulphacetamide with cortisone... ... 91
Sulphonamides in experimental corneal infection 30
Summerskill-Mules's implant 416
Suppression, colour mixture and ... 46
—— in binocular vision 37

PAGE

Suppression, macular 610
——, logarithmic argument 48
——, varieties of... ... ... 44, 47
Surface, refracting, cornea as... ... 77
Surgery, cataract 558
—— in diabetics 718, 725
—— in sclerotomy 223
——, intra-ocular, in Egypt 185
—— of implantation, scleral 420
—— —— ——, lens 423
Sweden, ophthalmology in 257
Symblepharon treated with skin graft ... 236
Sympathectomy 70
Sympathetic block, pupillary effect ... 73
Sympathetic ophthalmia 92, 159, 416, 418
—— ——, pathology 756
—— ——, retinal detachment and ... 755
Sympathetic nervous system 54
—— ——, glaucoma and 70
Synechiae in sarcoidosis 248

Tachometer 439
Tantalum implants 265
Target cells 353, 356, 357
Tears, hypertonicity of 202
Television viewing, optics of 665
Tenon's fascia, implants and ... 265, 415
Tension, ocular 54, 59, 157
——, ——, amyl nitrite and 741
——, ——, blood osmotic pressure and 333
——, ——, —— pressure and 444
——, ——, diurnal variation in ... 2
——, ——, external pressure and 641, 642, 645
——, ——, hexamethonium and ... 298
——, ——, in cataract surgery... ... 259
——, ——, in glaucoma 1, 616, 641, 743
——, ——, miotics and... 298
——, ——, oculomotor nerve and ... 54
——, ——, of dog 670
——, ——, paracentesis and 434
——, ——, phasic variations in 293, 444, 650
——, ——, perilimbal vessels and ... 293
——, ——, retinal ischaemia and ... 677
——, ——, sympathectomy and ... 70
——, ——, vascular tone and 295
——, ——, venous pressure and ... 444
——, ——, vitreous body and 232
Terramycin in osteomyelitis 630
—— in pyocyaneus infection 342
—— in trachoma 106
Test, amyl nitrite 741
——, bulbar pressure 641
——, —— ——, clinical application ... 647
——, —— ——, miotics and 650
——, —— ——, optimum compression 645
——, diplopia
——, Druault's 462
——, Emsley-Fincham... ... 462, 463
——, jugular compression 330
——, Mantoux 405
——, Middlebrook-Dubos 413
—— objects in visual acuity ... 662, 664
—— pattern, Cobb-Moss ... 665, 667

PAGE

Test, water-drinking 330
Testosterone in diabetes 721
Thalassaemia 353
——, clinical findings 355
——, intravascular thrombosis in ... 354
Thiamin deficiency, experimental, and visual pathway 11
—— ——, ——, pathology of ... 19, 21, 24
Thrombosis, intravascular, in thalassaemia 354
Tissue therapy in trachoma 102
—— —— in retinal disease 536
"—— **tension**" theory... ... 196, 220
Tonometer, Schiötz 54, 644, 647, 699
——, standardization of 694
Toxoplasma preparations 325, 326, 504
Toxoplasmin reaction 326, 689
Toxoplasmosis 321
——, colour photographs facing ... 68
——, pathology 323
——, serology 326
——, congenital 689
——, complications 690
——, serology 689
Trachoma 102, 106, 185
——, grattage in 621
——, symptoms of 108
——, terramycin in 106
——, treatment of pannus by tissue therapy 102
Transparency of cornea 82
Trauma, nystagmus and 273
Treacher Collins' syndrome 171
Tremor, head, in nystagmus 609
Trephining, technique of 7, 306, 562, 618
Trichromatism 154
Tuberculin in treatment 406
—— response in sarcoidosis ... 247, 249
—— tests 405
Tuberculosis, ocular 405
——, ——, cortisone and 90
——, ——, diagnosis 407
——, ——, treatment 405, 406
Tubocurarine: *See* Curare
Tumour, orbital 758

Ulcer, corneal, polymixin in 30, 34, 341, 369, 370
——, dendritic 95
——, hypopyon 30, 369
——, proteolytic... 34
Ultra-violet absorption spectra... 231, 232
Uvea, circulation in, amyl nitrite and... 742
Uveitis 159, 412
——, atropine in... 87
——, cortisone in 85, 86
——, glaucoma and 434
——, hydrocortisone and 94
——, toxoplasmosis and 322
——, anterior, complicating mumps ... 99
Uveo-parotid fever: *See* Sarcoidosis ...

Vascularization, corneal, mechanism of 193, 210

PAGE

Vasoconstriction, oxygen and 518
Vasodilation 299
——, amyl nitrite and 745
—— in glaucoma 295
Vasomotor tone, cortisone and 208
Vein, central retinal, in thalassaemia ... 354
——, aqueous ... 73, 293, 296, 577
——, ——, anatomy of 577
——, ——, hexamethonium and ... 297
——, ——, ocular tension and 297, 444, 445
——, ——, Neoprene studies of ... 577
——, episcleral, ocular tension and ... 444
——, retinal, sympathetic block and ... 74
Vernal catarrh, steroid hormones and ... 94
Vessels, atrophy of, in choroidal sclerosis 145
—— degeneration of, glaucoma and 293, 618
—— 'obstruction' of, in glaucoma ... 650
——, occlusion of, in choroidal sclerosis 145
——, retinal 282
——, choroidal, Neoprene casts of ... 141
——, ——, pathology of 138
Viper bite, blindness after 120
Vision, binocular, nystagmus and ... 609
——, ——, suppression theory of ... 37
——, pattern, amblyopia and 424
Visual acuity 312
—— ——, cinema and 3
—— ——, cone distribution and ... 538
—— ——, definition 661
—— ——, nystagmus and 610
—— ——, optics of 541
—— ——, television and 665
—— angle, acuity and 540
—— fields in glaucoma 1, 8
—— ——, —— Löffler's syndrome ... 736
—— pathway, degeneration of ... 11
Vitamins, capillary fragility and ... 729
——, deficiency of 17
—— in maculopathy 536
Vitreous body 229
—— ——, haemorrhage into 707, 709, 721
—— ——, in Eales's disease 315
—— ——, phase-contrast microscopy 343
—— ——, retinal detachment and ... 265
—— ——, slit-lamp examination ... 625
—— ——, zonular fibres and 346
—— humour 229
—— ——, ultra-violet absorption spectrum 231
Vogt, A. 262, 522

Water-balance 712
Water-drinking test 330
Wave-length discrimination ... 154, 156
Wheatstone's experiment 38
Wound healing in lens extraction ... 726
"—— hormones" 194

Xenon lamp 66
Xerosis, parenchymatous ... 102, 104

Zeiss-Nordenson retinal camera ... 65

MONOGRAPH SUPPLEMENTS

(BRITISH JOURNAL OF OPHTHALMOLOGY.)

Retinal Venous Thrombosis

No. 2 By R. FOSTER MOORE, F.R.C.S.
90 pages, with 32 figures and 31 charts of Fields of Vision. *Price* 5/-

The Nature of the Intra-ocular Fluids

No. 3 By W. STEWART DUKE-ELDER.
(Sir Francis Laking Prize 1926-1927.)
140 pages, with Bibliography. *Price* 7/6

The Nature of the Vitreous Body

No. 4 By W. STEWART DUKE-ELDER. 72 pages. *Price* 5/-

Radiant Energy

AS *(a)* A PATHOGENIC *(b)* A THERAPEUTIC AGENT IN OPHTHALMIC DISORDERS
(The Gifford Edmonds Prize in Ophthalmology.)
No. 6 By H. B. STALLARD, F.R.C.S. 128 pages. *Price* 7/6

The Mechanism of Accommodation

No. 8 By EDGAR F. FINCHAM, F.Inst.P. 80 pages. *Price* 5/-

On the Correlation of some Sensory and Physiological Phenomena of Vision

No. 9 By W. D. WRIGHT and RAGNAR GRANIT. 80 pages. *Price* 5/-

Ocular Onchocerciasis, including an Investigation in the Gold Coast

No. 10 By HAROLD RIDLEY, Temp.-Major, R.A.M.C.
58 pages, with 27 illustrations and 3 colour plates. *Price* 7/6

Uveal Sarcomata

No. 11 By J. D. MARTIN-JONES.
94 pages and 22 illustrations. *Price* 10/-

Ocular Vertical Deviations

No. 12 By J. RINGLAND ANDERSON, M.B., B.S., F.R.C.S.(Edin.)
108 pages, 37 illustrations. *Price* 12/6

An Experimental and Clinical Study of the Reaction of the Anterior Segment of the Eye to Chemical Injury, with special reference to Chemical Warfare Agents

No. 13. By IDA MANN, A. PIRIE and B. D. PULLINGER. *Price* 21/-
176 pages profusely illustrated, monochrome and two-colour, together with full colour art inset pages.

The Incidence and Causes of Blindness

No. 14. By ARNOLD SORSBY. *Price* 10/6
An International Survey.

Nos. 1, 5 & 7 are Out of Print.

The above may be obtained from the Publishing Manager,
"British Medical Journal", BRITISH MEDICAL ASSOCIATION HOUSE,
TAVISTOCK SQUARE, LONDON, W.C.1